SMART6™
User Manual

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SMART6 User Manual

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Antenna Module	One (1) Year
Cables and Accessories	Ninety (90) Days
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#6,243,409 B1		

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Notice

The following notices apply to the SMART6.

Changes or modifications to this equipment not expressly approved by NovAtel Inc. could result in violation of FCC, Industry Canada and CE Marking rules and void the user's authority to operate this equipment.

FCC Notices

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

SMART6 has been tested and found to comply with the emission limits for a Class B digital device, pursuant to part 15 of the FCC Rules. The Class B limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Re-orient or relocate the SMART6
- Increase the separation between the equipment and the SMART6
- Connect the equipment to an outlet on a circuit different from that to which the SMART6 is connected
- Consult the dealer or an experienced radio/TV technician for help

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

In order to maintain compliance as a Class "B" digital device, shielded cables should be used for the RS-232 serial data ports (Belden 1036A or equivalent) and twisted pair cable should be used for the CAN port (shielded twisted pair will improve CAN performance in electrically harsh environments). I/O signals should be referred to signal ground (connector pin 5) and not power ground (connector pin 9). If I/O signals route to different areas of the vehicle, dedicated signal grounds for I/O should be spliced into a common connection to connector pin 5 at a point close to the SMART6.

Industry Canada

SMART6 Class B digital apparatuses comply with Canadian ICES-003.

SMART6 appareils numérique de la classe B sont conforme à la norme NMB-003 du Canada.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

CE

The enclosures carry the CE mark.

"Hereby, NovAtel Inc. declares that this SMART6 is in compliance with the essential requirements and other relevant provisions of the R&TTE Directive 1999/5/EC, the EMC Directive 2004/108/EC and the RoHS Recast Directive 2011/65/EU."

WEEE

If you purchased your OEM6 family product in Europe, please return it to your dealer or supplier at the end of its life. The objectives of the European Community's environment policy are, in particular, to preserve, protect and improve the quality of the environment, protect human health and utilise natural resources prudently and rationally. Sustainable development advocates the reduction of wasteful consumption of natural resources and the prevention of pollution. Waste electrical and electronic equipment (WEEE) is a regulated area. Where the generation of waste cannot be avoided, it should be reused or recovered for its material or energy. WEEE products may be recognized by their wheeled bin label ().[1]

REACH

NovAtel strives to comply with the EU Directive EC 1907/2006 on chemicals and their safe use as per the Registration, Evaluation, Authorization and Restriction of Chemical substances (REACH) for its products, including the SMART6 product. Since REACH SVHC lists are updated occasionally, please contact NovAtel Customer Support if you require further information.

Cables may contain DEHP (CAS Number 117-81-7) in concentrations above 0.1% w/w.

1. Visit the NovAtel Web site at www.novatel.com/products/weee-and-rohs/ for more information on WEEE.

Customer Service

NovAtel Knowledge Base

If you have a technical issue, visit the NovAtel support website at www.novatel.com | Support | Helpdesk and Solutions | Knowledge and Forums. Through this page, you can search for general information about SMART® antennas and other technologies, information about NovAtel hardware, software, installation and operation issues.

Before Contacting Customer Support

Before you contact NovAtel Customer Support about a software problem perform the following steps:

1. Issue the following logging commands to collect data to a file on your computer for 15 minutes:

```
LOG VERSIONA ONCE
LOG RXSTATUSA ONCE
LOG RXCONFIGA ONCE
LOG RAWEPHEMA ONNEW
LOG BESTPOSA ONTIME 1
LOG RANGEA ONTIME 1
LOG GLORAWEPHEMB ONCHANGED[1]
```

2. Send the file containing the logs to NovAtel Customer Service, using either the NovAtel ftp site at ftp://ftp.novatel.com/incoming or the support@novatel.com e-mail address.

3. You can also issue a `FRESET` command to the receiver to clear any unknown settings.

> The `FRESET` command will erase all user settings and perform a factory reset. You should know your configuration and be able to reconfigure the receiver before you send the `FRESET` command.

If you are having a hardware problem, send a list of the troubleshooting steps taken and the results.

Contact Information

Use one of the following methods to contact NovAtel Customer Support:

Call the NovAtel Hotline at 1-800-NOVATEL (U.S. and Canada) or +1-403-295-4500 (international)	
Fax: +1-403-295-4501 E-mail: support@novatel.ca website: www.novatel.com	Write: NovAtel Inc. Customer Support Department 1120 - 68 Avenue NE Calgary, AB Canada, T2E 8S5

1. For GLONASS channel configuration.

Chapter 1 Introduction

The SMART6 is a high performance GNSS receiver and antenna, capable of receiving and tracking different combinations of GNSS L1/L2 code and carrier signals on a maximum of 120 channels. SBAS (Satellite Based Augmentation Systems) support, which includes WAAS (North America), EGNOS (Europe) and MSAS (Japan) is standard. Refer to NovAtel's GNSS Book for an overview of each of the above signal types. The SMART6 rear panel also features Light Emitting Diodes (LEDs) for status indication.

Once properly powered, the SMART6 begins operating as a fully functional GNSS system. *Figure 1, SMART6 Receiver* shows the SMART6 without connecting cables.

Figure 1: SMART6 Receiver

1.1 Features and Models

The main features of the SMART6 are:

- an enhanced high performance GNSS L1/L2 receiver
- a high performance GNSS L1/L2 antenna
- a CAN port
- three RS-232 COM ports or
  two RS-232 COM ports and Bluetooth
- three LED status indicators
- a water and dust tight enclosure
- Bluetooth wireless technology (optional)
- tilt compensation (optional)

The SMART6 is available in several different firmware models whose configurations may include other additional features. Some possible configurations can be seen in *Table 1, SMART6 Models*.

Table 1: SMART6 Models

NovAtel Part #	Description
01019123	SMART6
01019125	SMART6 with Tilt
01019121	SMART6 with Bluetooth
01019127	SMART6 with Bluetooth and Tilt

Contact NovAtel Sales at www.novatel.com/where-to-buy/contact-us for information regarding available models, upgrading a model to increase feature/functionality or go to www.novatel.com/support/firmware-downloads to obtain product updates. Refer to *Chapter 5, NovAtel Firmware and Software on page 38* for details.

Refer to the OEM6 Installation and Operation Manual for detailed information on receiver communications and operation.

1.2 Conventions

Conventions used in this manual are the following:

Note that provides information to supplement or clarify the accompanying text.

Caution that a certain action, operation or configuration may result in incorrect or improper use of the product.

Warning that a certain action, operation or configuration may result in regulatory noncompliance, safety issues or equipment damage.

- The letter H in the *Offset* columns of the commands and logs tables represents the header length for that command or log. Refer to the OEM6 Family Firmware Reference Manual for ASCII and binary header details.
- The number following 0x is a hexadecimal number.
- Command descriptions' brackets, [ ], represent the optionality of parameters.
- In tables where values are missing they are assumed to be reserved for future use.
- Status words are output as hexadecimal numbers and must be converted to binary format (and in some cases then also to decimal). For an example of this type of conversion, refer to the RANGE log in the OEM6 Family Firmware Reference Manual.
- Conversions and their binary or decimal results are always read from right to left.

Chapter 2 Installation and Setup

2.1 Additional Equipment Required

In order for the SMART6 to perform optimally, the following additional equipment is required:

- A cable harness for communicating and powering the SMART6 (NovAtel cable harness 01018999 is available with three DB-9 connectors, four bare cables and a SMART6 connector) or similar
- A fused power supply (user supplied) (refer to *Table 7, Recommended Fuse and Fuse Holders* on *Page 51* for details)
- A computer (user supplied)

2.1.1 SMART6 Setup

Complete the following steps to connect and power the SMART6.

1. Mount the SMART6 on a secure, stable structure with an unobstructed view of the sky from horizon to horizon (refer to *Section 2.1.4 Mounting the SMART6 on page 16* for details).
2. Connect the NovAtel interface cable, or custom wiring harness, to the *COM and Power* port on the back of the SMART6, see *Figure 2, SMART6 Connector*.

Figure 2: SMART6 Connector

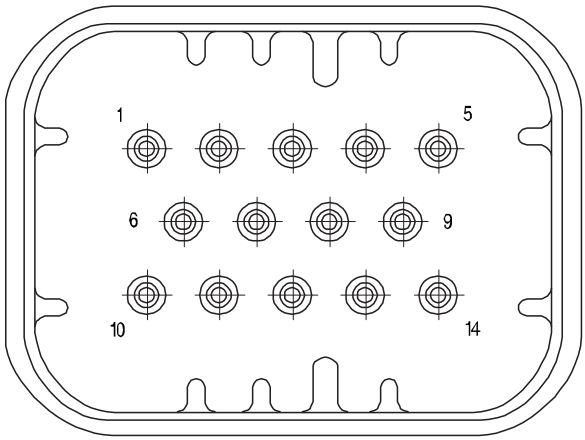


Table 2: SMART6 Connector Pin-Out

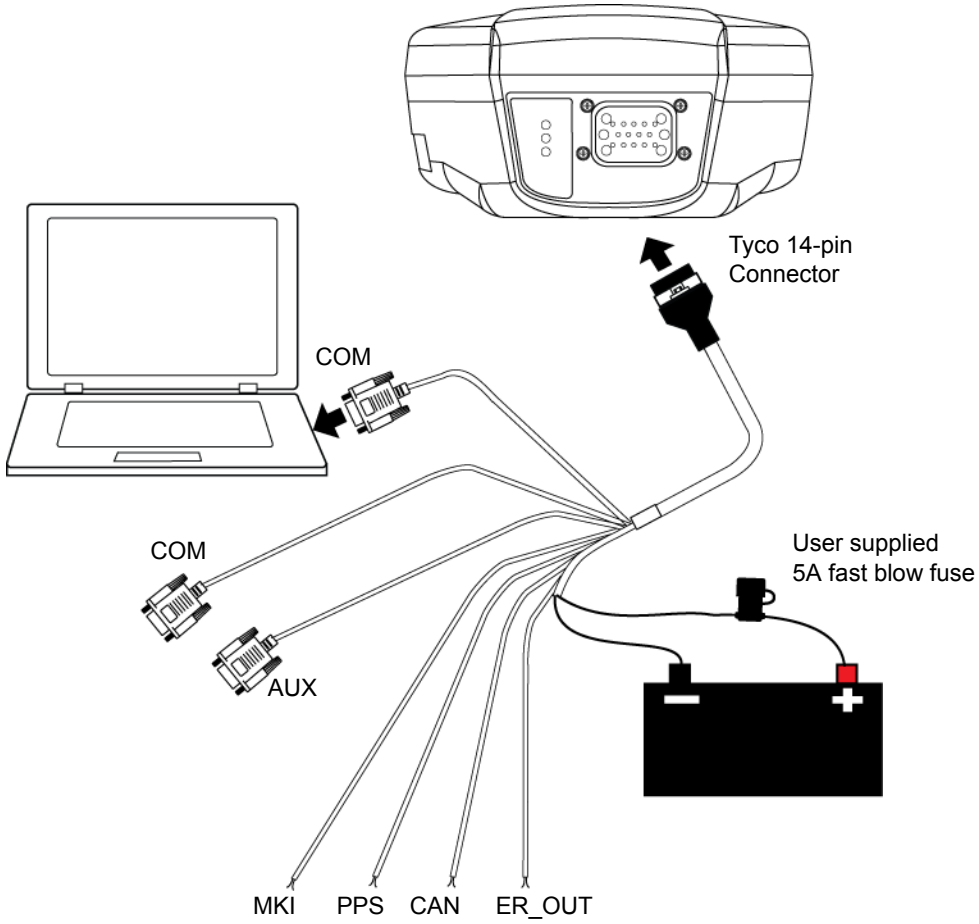
Pin	Use	Pin	Use
1	COM1 TxD	8	AUX TxD[a]
2	COM1 RxD	9	Power Negative/Return
3	COM2 TxD	10	ER_OUT (Emulated Radar Output)
4	COM2 RxD	11	MKI (Mark Input)
5	Signal Ground (COM/MKI/PPS/ER)	12	PPS (Pulse Per Second) Output
6	CAN+	13	AUX RxD[a]
7	CAN-	14	Power Positive/Source

a. On Bluetooth models, the AUX port is dedicated for Bluetooth communication and is not available through the SMART6 connector.

3. Connect the NovAtel cable or custom wiring harness to a DB-9 serial port on a computer or other data storage device.
4. Connect the NovAtel cable or custom wiring harness to the power supply and turn on the power supply to the SMART6 (the SMART6 cable is also a power cable). The power LED on the receiver glows red when the SMART6 is properly powered.

Fuse/holder recommendations can be found in *Table 7, Recommended Fuse and Fuse Holders* on *Page 51*.

Figure 3: Simplified SMART6 Setup



Minimum conductor size for all wiring is 0.5 mm/20 AWG.

2.1.2 Power Supply Requirements

The SMART6 requires +8 to +36 VDC input power (refer to *SMART6 Specifications on page 46* for additional power supply specifications).

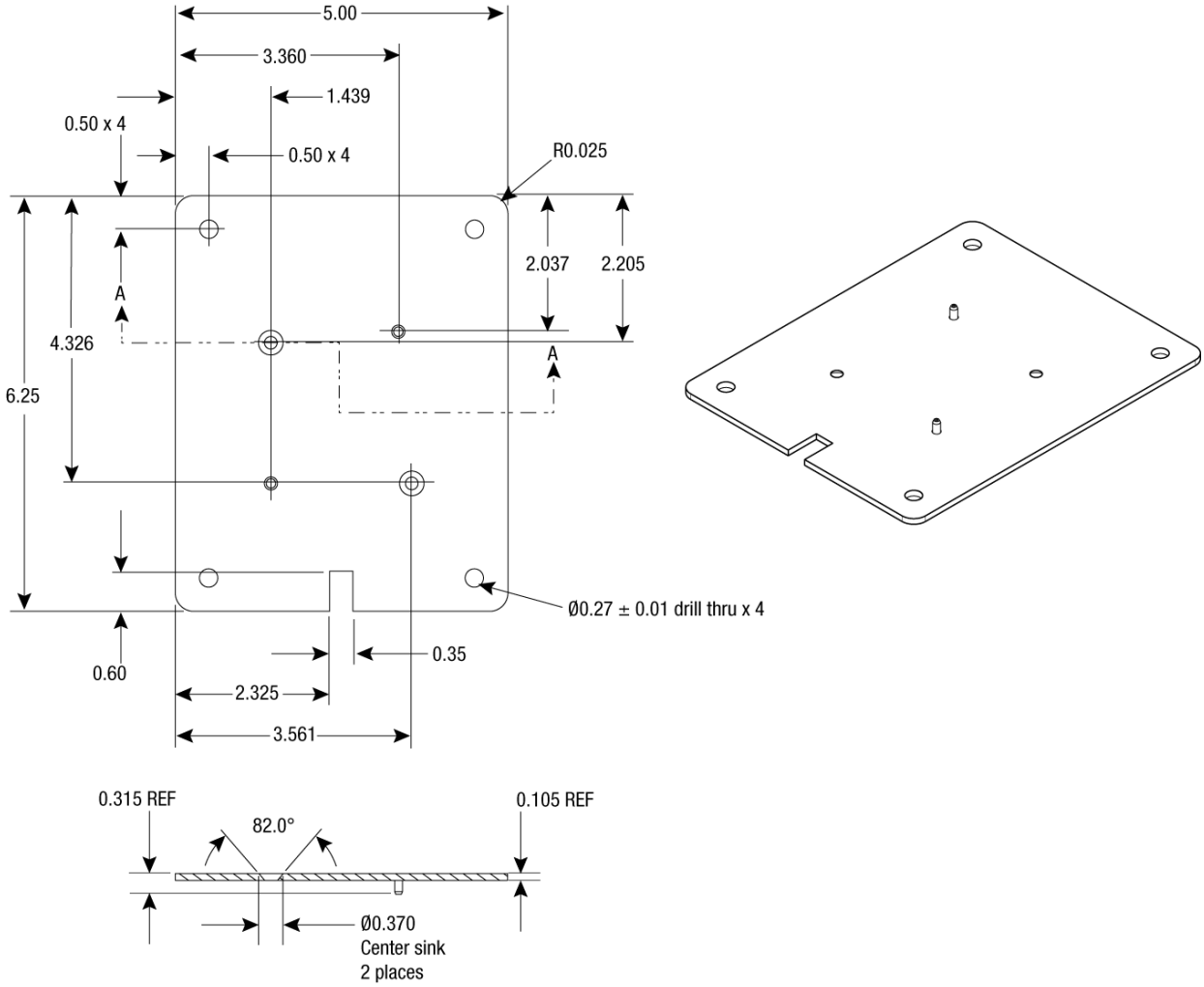
The SMART6 cable provides power in (BATT+) and power ground (BATT-) bare wires for connecting the SMART6 to a vehicular power system (or equivalent).

The SMART6 power source must be protected by a 5 A Fast Blow Fuse or damage to wiring may result (not covered by warranty). Refer to *SMART6 Connector and Cable Requirements on page 50)*.

2.1.3 Mounting Plate

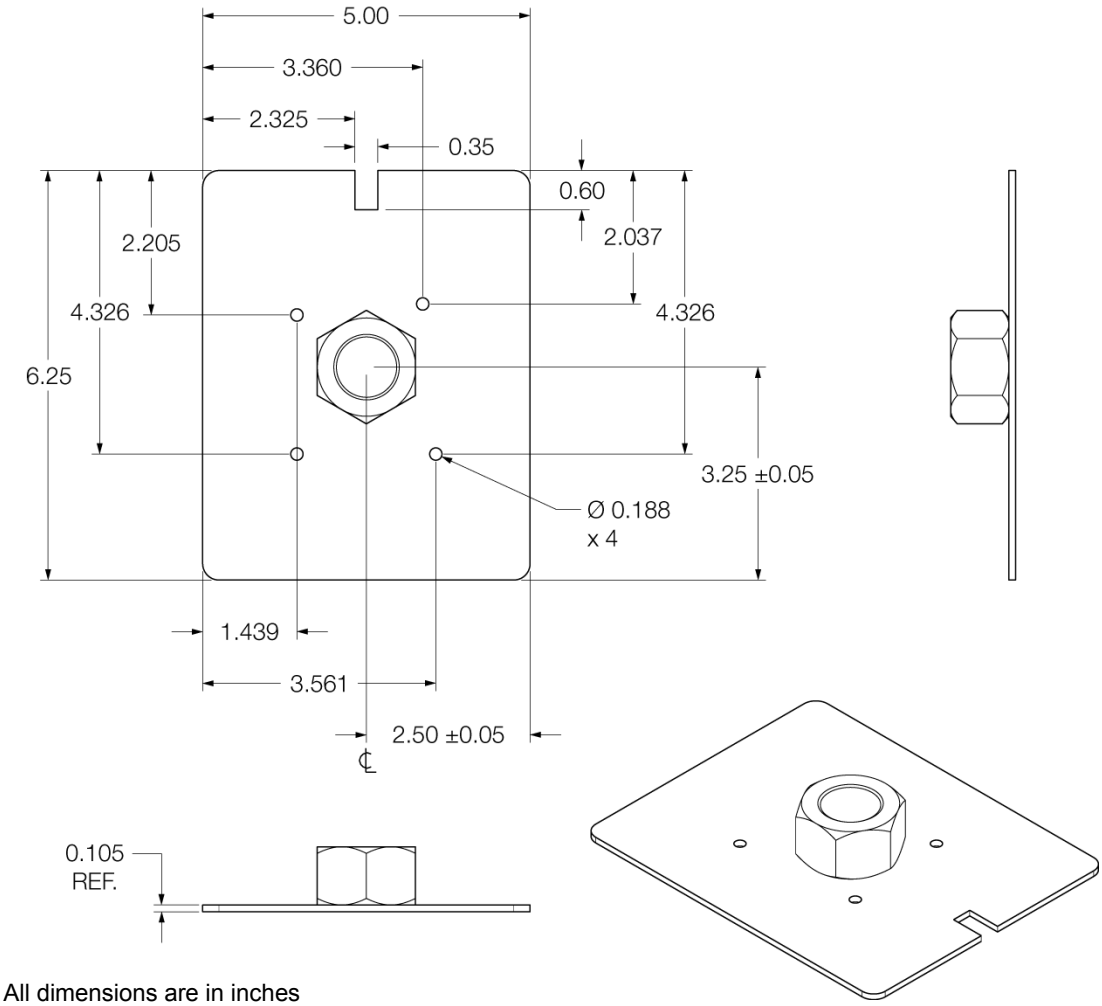
Two mounting plates are available to facilitate mounting the receiver: a surface mounting plate and a pole mounting plate.

Figure 4: SMART6 Surface Mounting Plate (01018317)



To install the mounting plate, use the adhesive tape or the mounting holes at each corner of the plate.

Figure 3: SMART6 Pole Mounting Plate (01019142)



All dimensions are in inches

To install the pole mounting plate:

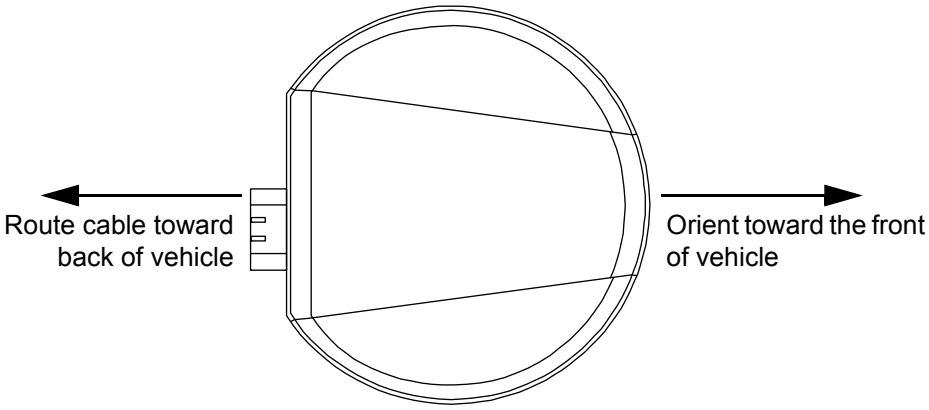
1. Use four M4 screws to connect the mounting plate to the SMART6.
2. Screw the mounting plate onto a mount, such as a range pole, tribrach, or tripod, with a 1" x 14 thread.
   A 5/8” to 1” bushing adaptor is available (part number 12023275).

2.1.4 Mounting the SMART6

Mount the SMART6 on a secure, stable structure capable of safe operation in the specific environment.

- If installing on a vehicle, mount the SMART6 on the vehicle roof, ideally close to the pivot point of the vehicle. The SMART6 must be mounted with the connector facing the rear of the vehicle (see *Figure 5, SMART6 Orientation*).

Figure 5: SMART6 Orientation



The SMART6 must be rigidly secured to the vehicle to avoid errors caused by vibration and motion.

- If installing in a stationary location, mount the SMART6 in a location that has a clear view of the sky so that each satellite above the horizon can be tracked without obstruction. For more information, refer to NovAtel's GNSS Book.

2.1.5 Connecting Data Communications Equipment

To communicate with the receiver for sending commands and obtaining logs, a connection to data communications equipment is required. Refer to *Table 5, SMART6 Communication/Power Cable Pinouts* on *Page 50* on for more information.

2.2 Additional Features and Information

This section contains information on the additional features of the SMART6, which may affect the overall design of the receiver system.

2.2.1 Status Indicators

LED indicators on the SMART6 provide the status of the receiver. The table below shows the meaning of the LEDs.

Table 3: SMART6 LED Status Indicators

Red	Yellow	Green	Condition
Off	Off	Off	Power is not available. (Red indicator may also not be lit if a boot failure has occurred.)
On	Off	Off	Power is available but no satellites are being tracked yet.
On	Flashing	Off	Tracking at least one satellite but not a valid position.
On	On	Off	Position valid in basic autonomous mode.
On	On	Flashing	SBAS tracking, but not enough data for enhanced solution.
On	On	On	Position valid in an enhanced accuracy mode (WAAS/EGNOS/MSAS/DGPS).

Flashing means that the LED is turning on and off at a 1 Hz rate - 0.5 seconds on and 0.5 seconds off.

Troubleshooting:

- If the power is on but the yellow LED does not flash within one minute, then no satellites are being tracked. There may be excessive blockage or the SMART6 may be defective. Make sure the SMART6 has an unobstructed view of the sky. Try power cycling the SMART6.
- If the yellow LED is flashing but doesn't progress to solid yellow within one minute, then insufficient satellites are being tracked or the signal quality is poor and ephemeris data cannot be received. Normally, four satellites are sufficient for a valid position as long as they are widely distributed in the sky. If LED is stuck on blinking yellow, there may be excessive signal blockage or the SMART6 may be defective. Make sure the SMART6 has an unobstructed view of the sky. Try power cycling the SMART6.
- If the yellow LED is on, but the green doesn't turn on within five minutes than no SBAS or DGPS positions are available. If you are using SBAS, make sure SBAS is available in your area and that the SMART6 is configured to enable SBAS positions (SBASCONTROL ENABLE). For DGPS, make sure the SMART6 is configured with the correct serial port parameters and to accept the DGPS protocol your area is using and that your data modem is connected and working.
- The green LED blinks when SBAS is detected then it comes on solid when SBAS is enabled. The LED will stay dark if SBAS is not detected.

2.2.2 MKI and PPS Strobes

The Mark Input (MKI) and Pulse Per Second (PPS) strobe provide status and synchronization signals. PPS is a 3.3 V CMOS output; MKI is a 5 V logic tolerant input.

Pin-out information can be found on *Table 5, SMART6 Communication/Power Cable Pinouts* on page 50.

2.2.3 Emulated Radar (ER)

The SMART6 outputs an emulated RADAR signal via the bare wires labeled ER GND and ER_OUT on the SMART6 cable. See *Table 5, SMART6 Communication/Power Cable Pinouts* on page 50 for the pin-out details of this cable.

The ER outputs a logic high of supply voltage minus 0.5 V minimum and logic low of 0.5 V maximum with a rise and fall time of less than 1 ms. Its output references signal GND and provides logic low output until its speed is greater than 1 km/Hr. ER can be configured to operate at one of three distinct frequencies (26.11, 28.12 or 36.11 Hz/km/Hr, with 26.11 Hz/km/Hr being the default value) and with an effective range from 1 km/Hr to 55 km/Hr for near-horizontal applications. See *Section B.7, RADARCFG Configure the ER Output* on page 61 for more information.

2.2.4 Controller Area Network (CAN)

The SMART6 supports the following NMEA2000 Parameter Group Messages (PGN):

- PGN 129029 GNSSPositionData (1 Hz)
- PGN 129025 GNSSPositionRapidUpdate (10 Hz)
- PGN 129026 COGandSOGRapidUpdate (10 Hz)

The CAN must be activated by entering the `SETCANNAME` command (refer to *B.9 SETCANNAME Sets the CAN name fields* on *page 64*). To have the CAN set up automatically at subsequent start ups, also send the `SAVECONFIG` command.

Table 4: Available CAN Signals on the SMART6

CAN	Pins
CAN+	Pin 6
CAN-	Pin 7

Details for the PGN messages can be found in the NMEA2000 specification which can be purchased directly from the National Marine Electronics Association (www.nmea.org/).

2.2.5 Tilt Compensation

The SMART6 Tilt Compensation feature corrects for errors in position caused by tilting of the vehicle.

Refer to *Tilt Compensation* on page 29 for a detailed description of the Tilt Compensation feature.

To fully install and set up tilt compensation:

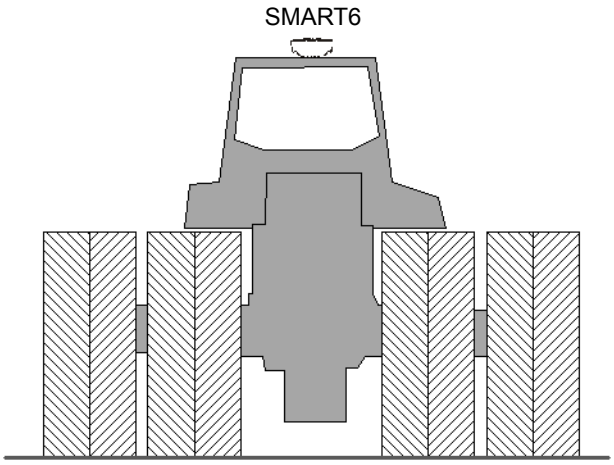
1. Mount the SMART6 on the vehicle.
2. Measure, set and save the height of the SMART6 from the ground.
3. Level the tilt sensor and save the data.

Refer to *$PMDT Configure Tilt Compensation* on page 60 for height, level and update commands.

2.2.5.1 Physical Installation

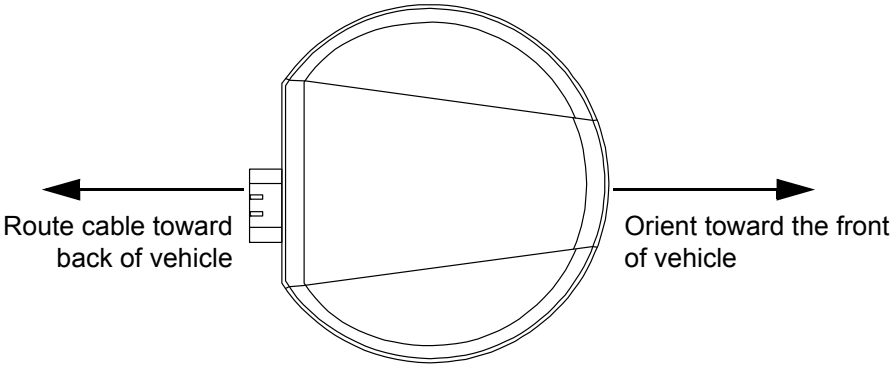
The SMART6 must be mounted as close to the center of the vehicle as possible, as illustrated in *Figure 6, SMART6 Installation*.

Figure 6: SMART6 Installation



The SMART6 must be mounted with the connector facing the rear of the vehicle, as shown in *Figure 7, SMART6 Orientation*:

Figure 7: SMART6 Orientation



The SMART6 must be rigidly secured to the vehicle to minimize errors due to vibration and motion.

2.2.5.2 Height Measurement and Configuration

The height measurement should be made while the vehicle has the correct tire pressure and is parked on a hard-packed and level surface. The measurement should be made from the ground to the bottom of the SMART6 connector. The measurement accuracy should be within 1 to 2 inches (2.5 to 5.0 cm).

Once the measurement has been made (in feet and inches, or metres), refer to *Section B.6, $PMDT Configure Tilt Compensation* on page 60 for instructions on how to set the height in the SMART6. The height must be saved after the height command is sent. This must be done so the height data is saved between power cycles. Instructions on sending the save command are outlined in *Section B.6, $PMDT Configure Tilt Compensation* on page 60.

Note that changes in tire pressure over time can potentially cause errors in tilt compensation. This is because the height of vehicle can vary with tire pressure.

The SMART6 is shipped from the factory with the height set to 0.0 metres.

2.2.5.3 Leveling the Tilt Sensor

The vehicle must be parked on flat ground when the level command is sent to the SMART6. Refer to *Section B.6, $PMDT Configure Tilt Compensation* on page 60 for instructions on how to send the level command.

After the tilt sensor has been leveled, the data must be saved to non-volatile memory using the save command. Instructions on using the save command are outlined in *Section B.6, $PMDT Configure Tilt Compensation* on page 60.

Chapter 3 Operation

Before operating the SMART6 for the first time, ensure the installation instructions in *Chapter 2, Installation and Setup* were followed. It is assumed that a computer is used during initial operation and testing for greater ease and versatility.

3.1 Communications with the Receiver

Communication with the receiver typically consists of issuing commands through the communication ports from an external serial communications device. This could be either a terminal or computer connected directly to the receiver serial port using a DB-9 connector on the SMART6 communication/power cable. If using a radio, connect it to another DB-9 connector on the same communication/power cable by means of the radio serial cable supplied with the radio. It is recommended that you become thoroughly familiar with the commands and logs detailed in the OEM6 Family Firmware Reference Manual to ensure maximum utilization of the receiver's capabilities.

3.1.1 Serial Port Default Settings

The receiver communicates with the computer or terminal via an RS-232 serial port. For communication to occur, both the receiver and the operator interface have to be configured properly. The receiver's COM1 and COM2 default port settings are:

- 9600 bps, no parity, 8 data bits, 1 stop bit, no handshaking, echo off

The receiver's AUX default port settings are:

- 9600 bps, no parity, 8 data bits, 1 stop bit, no handshaking, echo off

To change the default settings, use the `SERIALCONFIG` command. See *Appendix B.8, SERIALCONFIG Configures serial port settings* starting on *Page 62* for details.

The data transfer rate chosen determines how fast information is transmitted. For example, outputting a log whose message byte count is 96. The default port settings allows 10 bits/byte (8 data bits + 1 stop bit + 1 framing bit). It therefore takes 960 bits per message. To get 10 messages per second, 9600 bps is required. Also remember that even if the bps is set to 9600, the actual data transfer rate is lower and depends on the number of satellites being tracked, data filters in use and idle time. It is suggested a margin is set when choosing a data rate (115200 is recommended for most applications).

Although the receiver can operate at data transfer rates as low as 300 bps, this is not desirable. For example, if several data logs are active (that is, a significant amount of information needs to be transmitted every second) but the bit rate is set too low, data will overflow the serial port buffers, causing a warning in the receiver status and loss of data.

3.1.2 Communicating Using a Remote Terminal

One method of communicating with the receiver is through a remote terminal. The receiver is pre-wired to allow proper RS-232 interface with the data terminal. To communicate with the terminal, the receiver only requires the RX, TX and GND lines to be used. Request to Send (RTS)/Clear to Send (CTS) hardware handshaking is not available. Ensure the terminal's communications set up matches the receiver's RS-232 protocol.

3.1.3 Communicating Using a Computer

A computer can be set up to emulate a remote terminal as well as provide the added flexibility of creating multiple command batch files and data logging storage files. Any standard communications software package, that emulates a terminal, can be used to establish bidirectional communications with the receiver. For example, HyperTerminal or NovAtel's Graphical User Interface (GUI) program NovAtel Connect™. All data is sent as raw 8-bit binary or ASCII characters.

3.2 Getting Started

3.2.1 Starting the Receiver

When first powered, the SMART6 undergoes a complete self-test. The results of this test can be viewed by connecting to the receiver and requesting the RXSTATUS log. Refer to the OEM6 Family Firmware Reference manual for details.

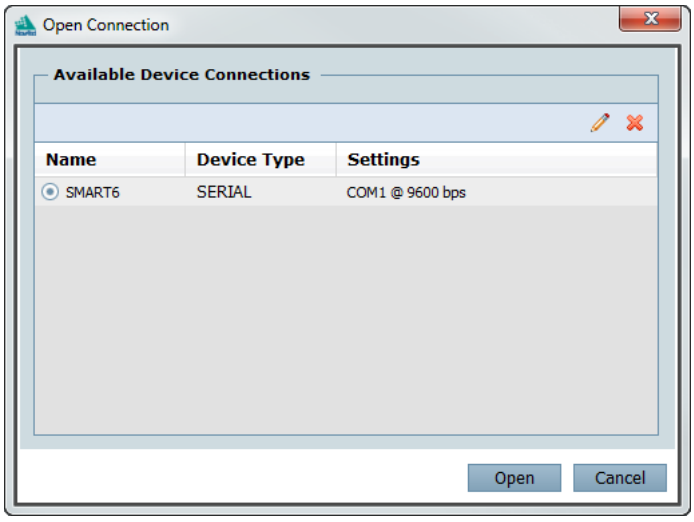
If a persistent error develops, contact your local NovAtel dealer first. If the problem remains unresolved, contact NovAtel directly through any of the methods listed in the *Customer Service* section on *page 9*.

3.2.2 Communicating with the Receiver Using NovAtel Connect

NovAtel Connect is a Windows based GUI used to access the receiver's many features. Convert is a utility that converts between file formats and strips unwanted records for data file compilation. Both are included in the NovAtel Connect PC Utilities bundle available from: www.novatel.com/support/search/items/PC%20Software.

Launch the NovAtel Connect program and select *Device* | *Open Connect* from its main menu. The *Open Connection* window appears.

Figure 8: Open Connection Window



Refer to the NovAtel Connect help file or press F1 while the cursor is in a NovAtel Connect window. Ensure the *Console* and *ASCII Messages* windows are open by selecting them from the *View* menu.

When the receiver is first turned on, no data is transmitted from the COM ports except for the port prompt. The console window displays a port name:

[COM1] *if connected to COM1 port*
[COM2] *if connected to COM2 port*
[AUX] *if connected to AUX port or through Bluetooth*

Any of the above prompts indicate the receiver is ready and waiting for command input.

1. You may also have to wait for output from receiver self-tests. For example, on start-up, the SMART6 is set to log the RXSTATUSEVENTA log ONNEW on all ports. Refer to the OEM6 Family Firmware Reference Manual for more details.
2. If NovAtel Connect is unable to locate the SMART6, try using a different COM port to communicate to the receiver. Once communication has been established, issue the `FRESET STANDARD` command. You should now be able to use the original communication port again.
3. When using the AUX port, you must use a “Passive” connection in NovAtel Connect.

Commands are typed at the interfacing computing device's keypad and executed after issuing a carriage return command which is usually the same as pressing the <Enter> key.

An example of a response to an input command is the `FIX POSITION` command. It can be as:

```
[COM2] FIX POSITION 51.11635 -114.0383 1048.2 [Carriage Return]
<OK
```

where [COM2] is the port prompt, followed by the command entered and [Carriage Return] is a prompt to press the <Enter> key.

The example above illustrates the command input to the base receiver's COM2 port, which sets the position of the base station receiver for differential operation. Confirmation that the command was actually accepted is the appearance of `<OK`.

If a command is entered incorrectly, the receiver responds with:

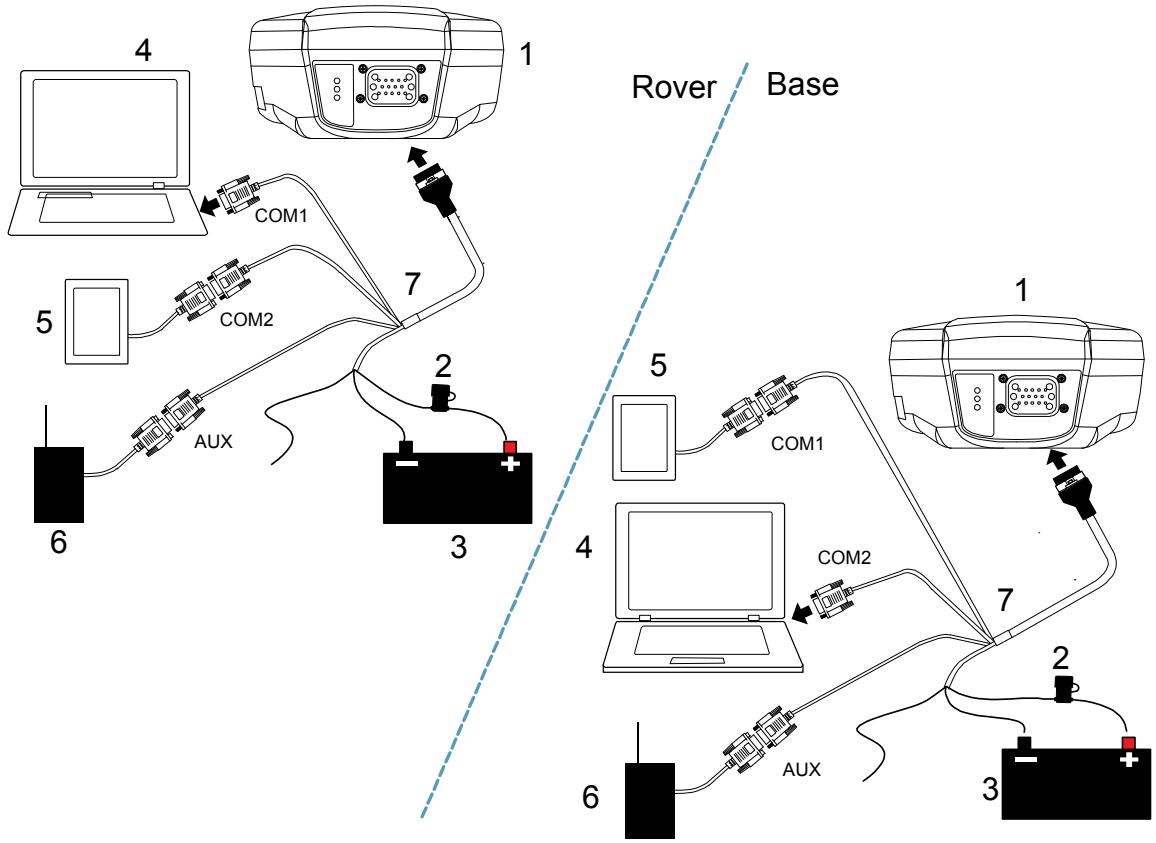
```
<Invalid Message ID          (or a more detailed message)
```

Ensure the computer's Control Panel Power Settings are not set to Hibernate or Standby modes. Data is lost if one of these modes occurs during a logging session.

3.3 Transmitting and Receiving Corrections

RTK or DGPS corrections can be transmitted from a base station to a rover station to improve position accuracy. The base station is the GNSS receiver, which is acting as the stationary reference. It has a known position and transmits correction messages to the rover station. The rover station is the GNSS receiver which does not know its exact position and can be sent correction messages from a base station to calculate differential GNSS positions. The SMART6 can be used as a base receiver to transmit RTK or DGPS corrections or a rover to receive the same corrections. An example of a differential setup is given in *Figure 9, Basic Differential Setup* on page 24.

Figure 9: Basic Differential Setup



Reference	Description
1	SMART6 receiver
2	User supplied 5 A fast blow fuse
3	User supplied power supply, for example a battery
4	User supplied device to COM1
5	User supplied device to COM2
6	User supplied device to AUX
7	User supplied cable or NovAtel 01018999 Communication/Power cable

The configuration shown in *Figure 9, Basic Differential Setup* is valid for SMART6 receivers without optional Bluetooth.

For a SMART6 receiver with Bluetooth, two of the serial devices connect through COM1 and COM2 and the other device must connect through Bluetooth.

System biases can introduce errors, refer to our *GNSS Book* found on our Web site at www.novatel.com/an-introduction-to-gnss/ for more information. In most cases, a data link between the base station and rover station (two NovAtel receivers) is required to receive corrections. SBAS corrections can be accomplished with one receiver and are exceptions to the base/rover concept. Generally, a link capable of data throughput at a rate of 9600 bits per second and less than 4.0 s latency is recommended.

Once the base and rover are set up, configure them as shown in the configuration examples that follow in *Section 3.3.1, Base Station Configuration* on page 25 and *Section 3.3.2, Rover Station Configuration* on page 26.

3.3.1 Base Station Configuration

At the base station, enter the following commands:

```
SERIALCONFIG [port] baud [parity[databits[stopbits[handshaking[break]]]]]
interfacemode port rx_type tx_type [responses]
fix position latitude longitude height
log port message [trigger [period]]
```

Examples of these commands include the following:

RTCA

```
serialconfig com2 9600 N 8 1 N on
interfacemode com2 none rtca off
fix position 51.11358042 -114.04358013 1059.4105
log com2 rtcaobs ontime 1
log com2 rtcaref ontime 10
log com2 rtca1 ontime 5              (optional for RTK)
log com2 rtcaephem ontime 10 1       (optional)
```

RTCM

```
serialconfig com2 9600 N 8 1 N on
interfacemode com2 none rtcm off
fix position 51.11358042 -114.04358013 1059.4105
log com2 rtcm3 ontime 10       (required for RTK)
log com2 rtcm22 ontime 10 1    (optional)
log com2 rtcm1819 ontime 1
log com2 rtcm1 ontime 5
```

RTCMV3

```
serialconfig com2 9600 N 8 1 N on
interfacemode com2 none rtcmv3 off
fix position 51.11358042 -114.04358013 1059.4105
log com2 rtcm1006 ontime 10
log com2 rtcm1003 ontime 1
```

CMR+

```
serialconfig com2 9600 N 8 1 N on
interfacemode com2 none cmr off
fix position 51.11358042 -114.04358013 1059.4105
log com2 cmrobs ontime 1
log com2 cmrplus ontime 1    (Important to use ontime 1 with cmrplus)
```

CMR

```
serialconfig com2 9600 N 8 1 N on
interfacemode com2 none cmr off
fix position 51.11358042 -114.04358013 1059.4105
log com2 cmrobs ontime 1
log com2 cmrref ontime 10
log com2 cmrdesc ontime 10 1
```

3.3.2 Rover Station Configuration

At the rover station, enter:

```
SERIALCONFIG [port] baud [parity[databits[stopbits[handshaking[break]]]]]
interfacemode port rx_type tx_type [responses]
```

For example:

RTCA `interfacemode com2 rtca none off`

RTCM `interfacemode com2 rtcm none off`

RTCMV3 `interfacemode com2 rtcmv3 none off`

CMR+ `interfacemode com2 cmr none off`

CMR `interfacemode com2 cmr none off` *(same as CMR+)*

3.3.3 GPS + GLONASS Base and Rover Configuration

This section shows how to set up a base and rover OEM6 GPS + GLONASS enabled receivers for GPS + GLONASS RTK operation:

Base Station:

```
fix position lat lon hgt                    (enter your own lat, lon, and hgt values)
serialconfig com2 9600 N 8 1 N on
interfacemode com2 none rtca off
log com2 rtcaref ontime 10
log com2 rtcaobs2 ontime 1
log com2 rtca1 ontime 5                     (optional, enable code-DGPS coverage)
saveconfig                                  (optional, save configuration to non-volatile memory)
```

Rover Station:

```
serialconfig com2 9600 N 8 1 N on
interfacemode com2 rtca none off
log com1 bestposa ontime 1                  (optional, view position information)
saveconfig                                  (optional, save configuration to non-volatile memory)
```

3.3.4 Configuration Notes

For compatibility with other GNSS receivers and to minimize message size, it is recommended using the standard form of RTCA, RTCM, RTCMV3 or CMR corrections as shown in the base and rover examples above. This requires using the INTERFACEMODE command to dedicate one direction of a serial port to only that message type. When the INTERFACEMODE command is used to change the mode from the default, NOVATEL, you can no longer use NovAtel format messages.

To mix NovAtel format messages and RTCA, RTCM, RTCMV3 or CMR messages on the same port, leave the INTERFACEMODE set to NOVATEL and log out variants of the standard correction messages with a NovAtel header. ASCII or binary variants can be requested by simply appending an "A" or "B" to the standard message name. For example on the base station:

```
interfacemode com2 novatel novatel
fix position 51.11358042 -114.04358013 1059.4105
log com2 rtcm1b ontime 2
```

Using the receiver in this mode consumes more CPU bandwidth than using the native differential messages as shown in *Section 3.3.1, Base Station Configuration* on page 25.

At the rover station, leave the INTERFACEMODE default settings (interfacemode com2 novatel novatel). The rover receiver recognizes the default and uses the corrections it receives with a NovAtel header.

The PSRDIFFSOURCE and RTKSOURCE commands set the station ID values which identify the base stations from which to accept pseudorange or RTK corrections respectively. These are useful commands when the rover station is receiving corrections from multiple base stations. Refer to NovAtel's GNSS Book for more information on SBAS, available from www.novatel.com.

All PSRDIFFSOURCE entries fall back to SBAS (even NONE) for backwards compatibility (assuming SBAS was enabled).

At the base station it is also possible to log out the contents of the standard corrections in a form that is easier to read or process. These larger variants have the correction fields broken out into standard types within the log, rather than compressed into bit fields. This can be useful to modify the format of the corrections for a non-standard application or to look at the corrections for system debugging purposes. These variants have "DATA" as part of their names (for example, RTCADATA1, RTCMDATA1, CMRDATAOBS and more). Refer also to the OEM6 Family Firmware Reference Manual detailed descriptions of the various message formats.

Information on how to send multiple commands and log requests using DOS or Windows can be found on our web site at www.novatel.com/support/known-solutions/.

3.4 GLIDE

SMART6 contains NovAtel's GLIDE which is a positioning algorithm for single-frequency GPS and GPS/GLONASS applications. GLIDE produces a smooth position output tuned for applications where time relative accuracy (pass-to-pass) is more important than absolute accuracy. Because of this, it is well suited for agricultural applications.

Multipath signals tend to induce time varying biases and increase the measurement noise on the L1/L2 pseudorange measurements. Carrier phase measurements are much less susceptible to the effects of multipath. The GLIDE algorithm fuses the information from the L1 code and the L1 phase measurements into a Position Time Velocity (PVT) solution.

GLIDE includes settings for a dynamic mode, a static mode and an "auto" mode, where the filtering parameters are automatically adjusted as vehicle velocity varies between stationary and dynamic states.

3.4.1 Dual-Frequency GLIDE

NovAtel's dual-frequency GLIDE technology adds to the superior pass-to-pass performance provided by single-frequency GLIDE. Dual-frequency GLIDE is ideal for agricultural and machine guidance applications where relative positioning is critical. Using GLIDE significantly reduces the variation in position errors to less than 1 cm from one epoch to the next. Dual-frequency GLIDE improves the absolute accuracy of the GLIDE position and creates a robust solution resistant to the effects of high ionospheric activity. GLIDE works in all code positioning modes, including single point, DGNSS and SBAS.

Refer to the NovAtel white papers at www.novatel.com/support/search/items/White%20Paper for more information on GLIDE. Also refer to application note "APN-038 Pseudorange/Delta-Phase (PDP) and GL1DE Filters" at www.novatel.com/support/search/items/Application%20Note.

3.5 Emulated Radar (ER)

A typical radar sensor emits radio beams that bounce off the ground and computes ground speed based on the speed at which objects are passing in front of the sensor. The output of the sensor is a digital pulse, the frequency of which is proportional to the vehicle's ground speed. This is often used in agricultural applications such as planting and spraying. The SMART6 eliminates the need for separate ground-sensing radar equipment by converting the GPS-derived velocity to proportional frequency output. The following emulated radar signal parameters can be configured by the customer:

- Frequency Step: Specifies how the frequency output relates to the vehicle speed.
- Signal Update Rate: Specifies how often the frequency output is updated to match the vehicle speed.
- Response Mode: Specifies how quickly changes in velocity are reflected in the frequency output. Setting a slower response mode reduces spikes (noise) in the velocity but increases latency. Setting a higher response mode reduces latency, but may result in noisier frequency output. Refer to *RADARCFG Configure the ER Output* on page 61 for more detailed information.

After it is configured using the RADARCFG command, Emulated Radar (ER) pulses are output through the SMART6 cables (see *Table 5, SMART6 Communication/Power Cable Pinouts* on page 50) and the RADARSIGNAL log (see *RADARSIGNAL ER Signal and Position Information* on page 67).

3.6 Tilt Compensation

The SMART6 Tilt Compensation feature corrects for errors in position caused by tilting of the vehicle. The SMART6 senses the vehicle's roll angle and, with the user-entered "height above ground", compensates the position output to give the position under the vehicle rather than at the antenna.

Information about installation and setup can be found in:

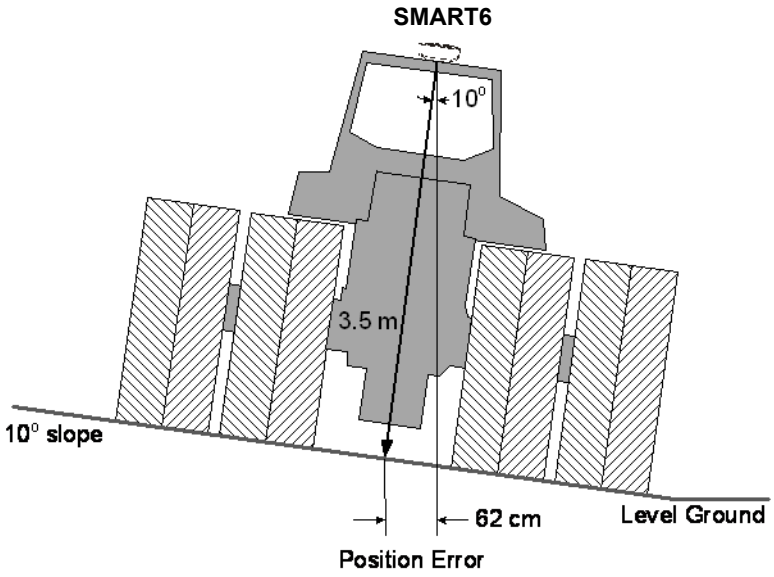
- *Tilt Compensation* on page 18

Information about tilt-compensation commands can be found in:

- *$PMDT Configure Tilt Compensation* on page 60

As shown in *Figure 10, SMART6 Tilt Compensation*, if an agricultural implement is operating on sloped terrain, the position will be in error by an amount proportional to the tilt angle.

Figure 10: SMART6 Tilt Compensation



If tilt compensation is enabled, the SMART6 determines the tilt and corrects the position data before it is forwarded to the user equipment. In the above example, the tilt is 10 degrees, and the position correction that needs to be applied is 62 cm.

The BESTPOS, BESTXYZ and all NMEA GPGGA logs will provide tilt-compensated position logs.

3.7 Recommended Configuration

The following command is recommended to enable CAN:

```
setcanname 305 2 0 0 23 0 0 28 can2
```

The following command is recommended to enable SBAS (WAAS/GNOS/MSAS) corrections:

```
sbascontrol enable
```

The following commands are recommended to enable GLIDE:

```
pdpfilter enable
pdpmode relative auto
```

NovAtel has registered manufactured ID code 305 with J1939. When complete, configuration can be saved with the SAVECONFIG command. For more information about these commands, refer to the OEM6 Family Firmware Reference Manual, available at www.novatel.com/support/manuals/.

Chapter 4 Bluetooth Configuration

Bluetooth is a wireless radio communication standard designed for use over short ranges (within 10 m). This chapter describes how to use the Bluetooth interface on the SMART6.

4.1 *Bluetooth* Wireless Technology on the SMART6 receiver

Bluetooth wireless technology is configured on the SMART6's internal AUX port. After your computer is configured for *Bluetooth* operation, use HyperTerminal or NovAtel Connect to communicate through AUX. To log data over the *Bluetooth* port, specify AUX as the output port (e.g. `log aux bestposa ontime 1`).

4.2 Pairing with a new SMART6

The AUX port, when used with Bluetooth, is automatically fixed to a data rate of 115,200 bps.

Ensure that your computer is equipped with a built-in, or external plug-in, *Bluetooth* adapter and is already configured with the appropriate *Bluetooth* driver.

The information in this section is specific to pairing an SMART6 with a Windows 7 based computer.

For information about pairing the SMART6 with other Bluetooth capable devices, refer to the devices user documentation.

To pair with an SMART6 in range:

1. Power on the SMART6.
2. Double-click the *Bluetooth* icon in the notification area, see *Figure 11* on page 31. The *Bluetooth Devices* window opens, see *Figure 12* on page 32.

Figure 11: Bluetooth Icon

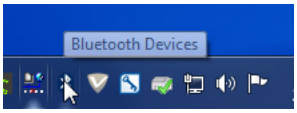
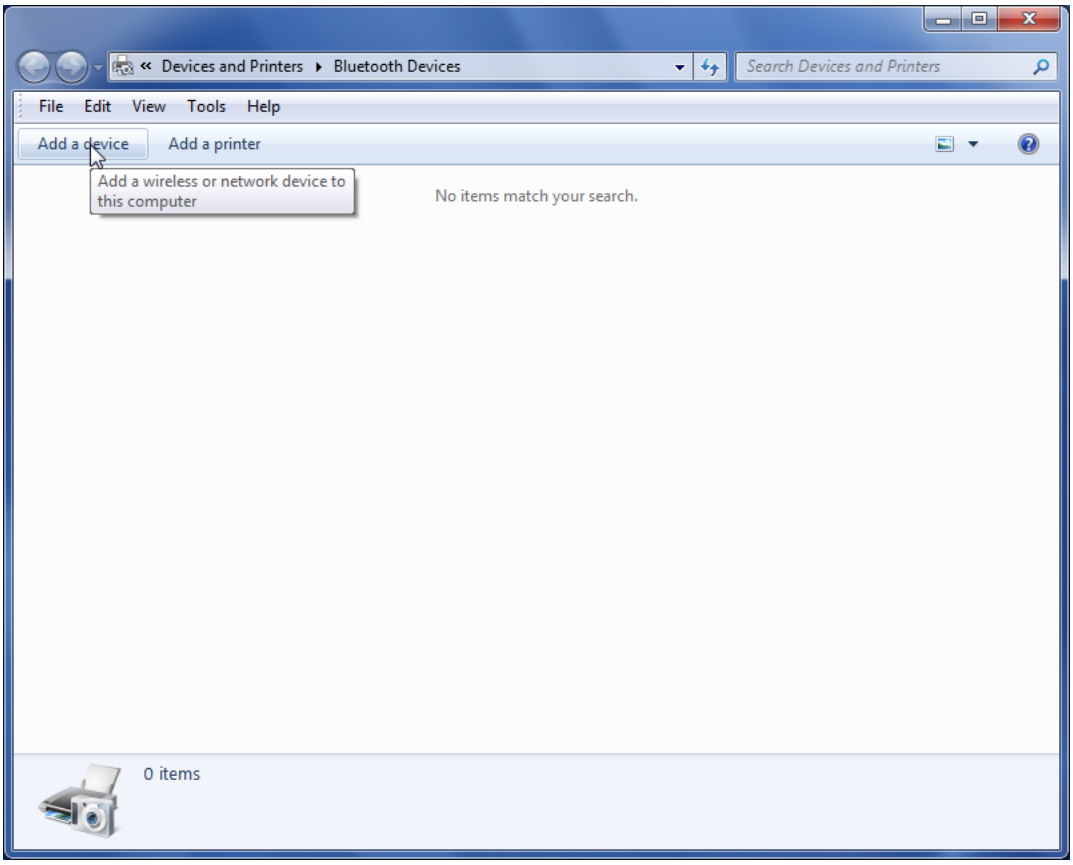
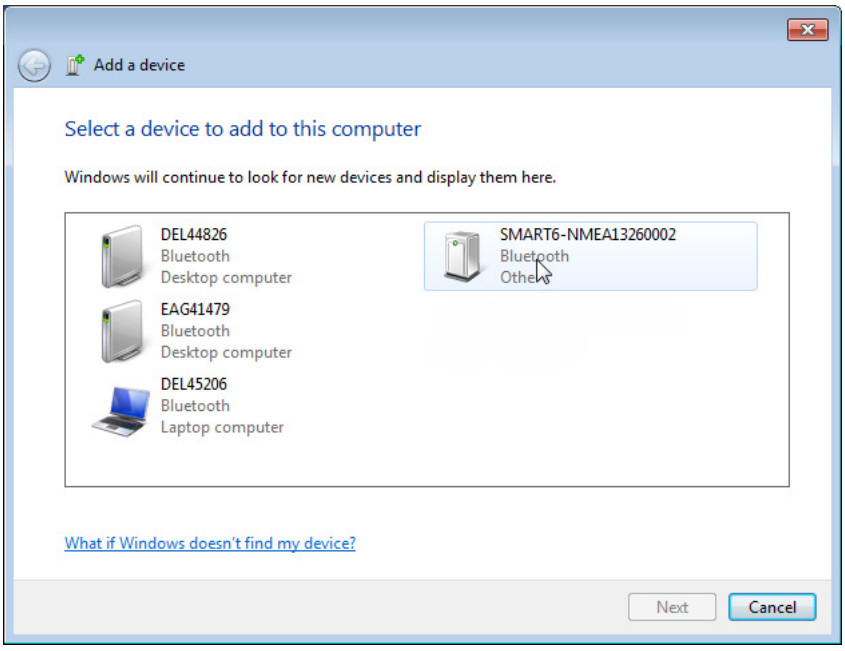


Figure 12: Bluetooth Devices Window



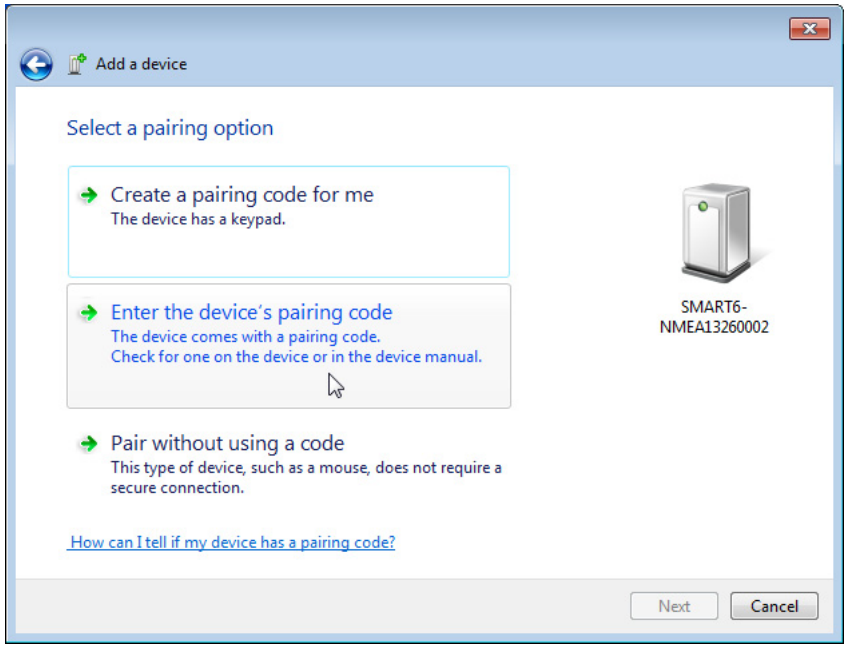
3. On the Bluetooth Devices window, click the *Add a device* button. The *Add a device* window appears. The computer searches for any Bluetooth device in range and displays the devices found on the window, see *Figure 13* on page 32.

Figure 13: Add a device window



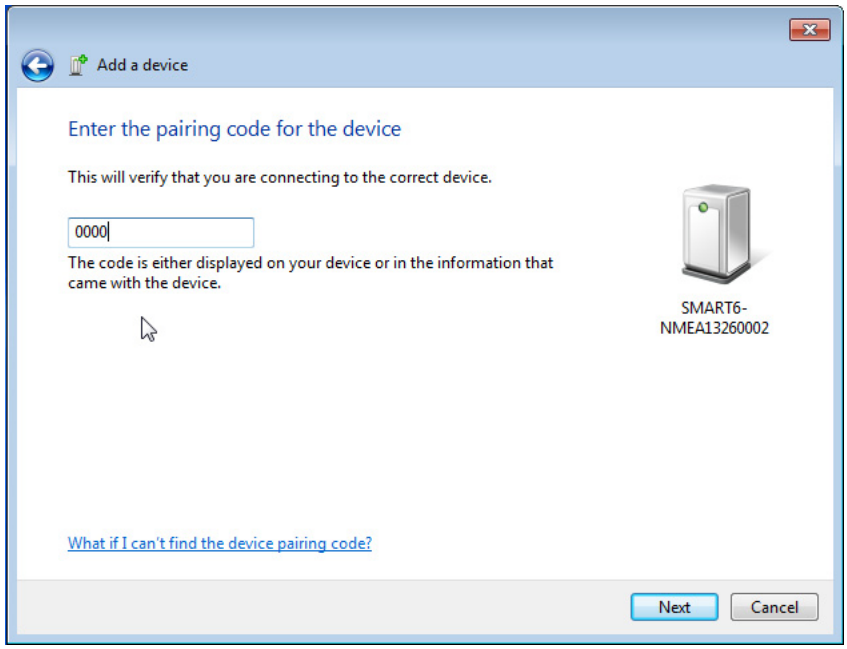
4. Select the SMART6 system and click the *Next* button. The *Select a pairing option* window appears, see *Figure 14* on page 33.

Figure 14: Add a device - Select a pairing option



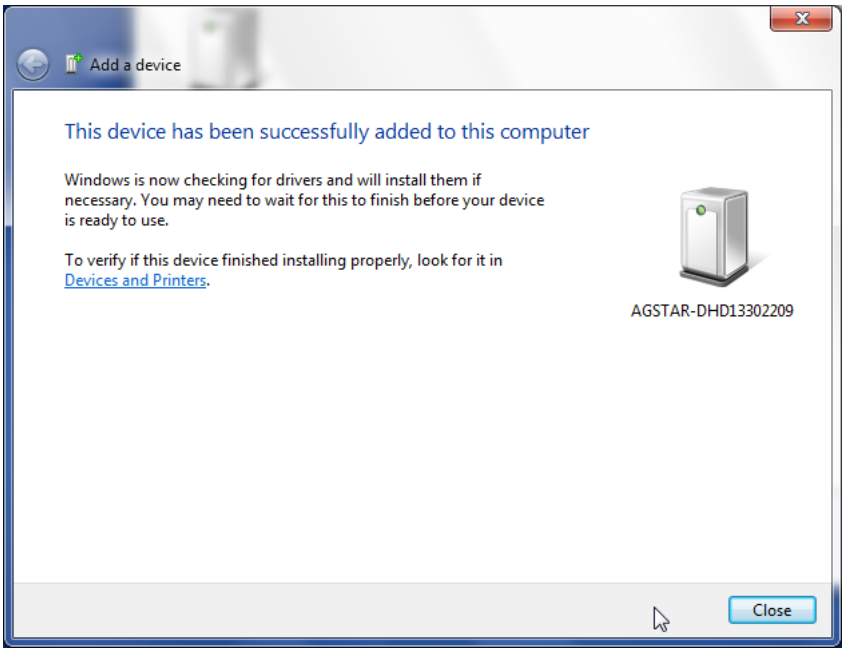
5. Click the *Enter the device's pairing code* button. The *Enter the pairing code for the device* window appears, see *Figure 15* on page 33.

Figure 15: Add a device - Enter pairing code



6. Type the SMART6 pairing code, **0000**, and click the *Next* button.
Windows installs the serial port driver and assigns a serial port number to the Bluetooth link. Make a note of the serial port number assigned. See *Figure 16, Add a device - Successful* on page 34.

Figure 16: Add a device - Successful



On some operating systems, the SMART6 must be re-paired every time it is restarted.

To re-pair in Windows 7, click the Bluetooth icon in the notification area and enter the pairing code when prompted.

For instructions on re-pairing in other operating systems, see the user documentation that came with the operating system.

4.3 Determining the Bluetooth Serial Port

To determine the serial port associated with the Bluetooth link to the SMART6:

1. Double-click the *Bluetooth* icon in the notification area, see *Figure 17* on page 34. The *Bluetooth Devices* window opens, see *Figure 18* on page 35.

Figure 17: Bluetooth Icon

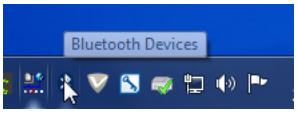
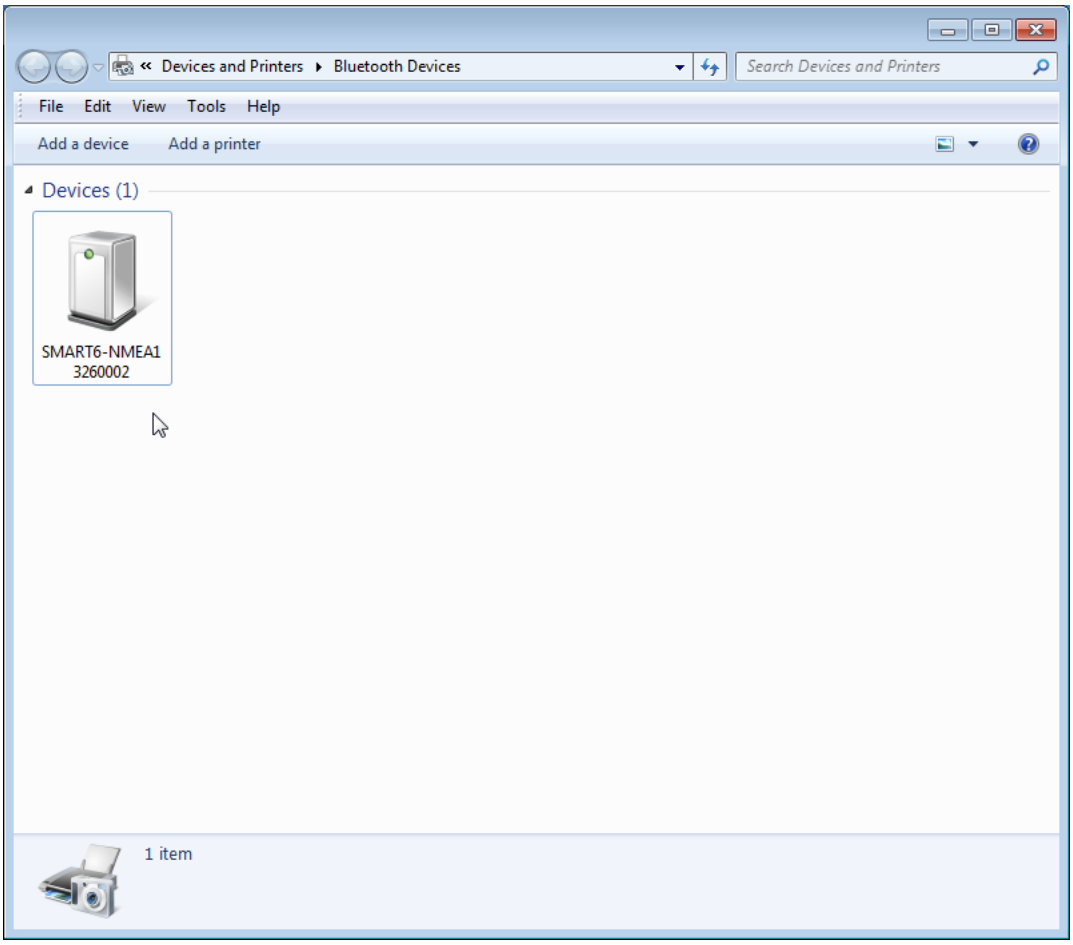


Figure 18: Bluetooth Devices Window



2. In the *Bluetooth Devices* window, right-click the SMART6 device and select *Properties*, see *Figure 19* on page 36.
   The Properties window for the SMART6 appears, see *Figure 20* on page 36.

Figure 19: Bluetooth Devices Window - Device Menu

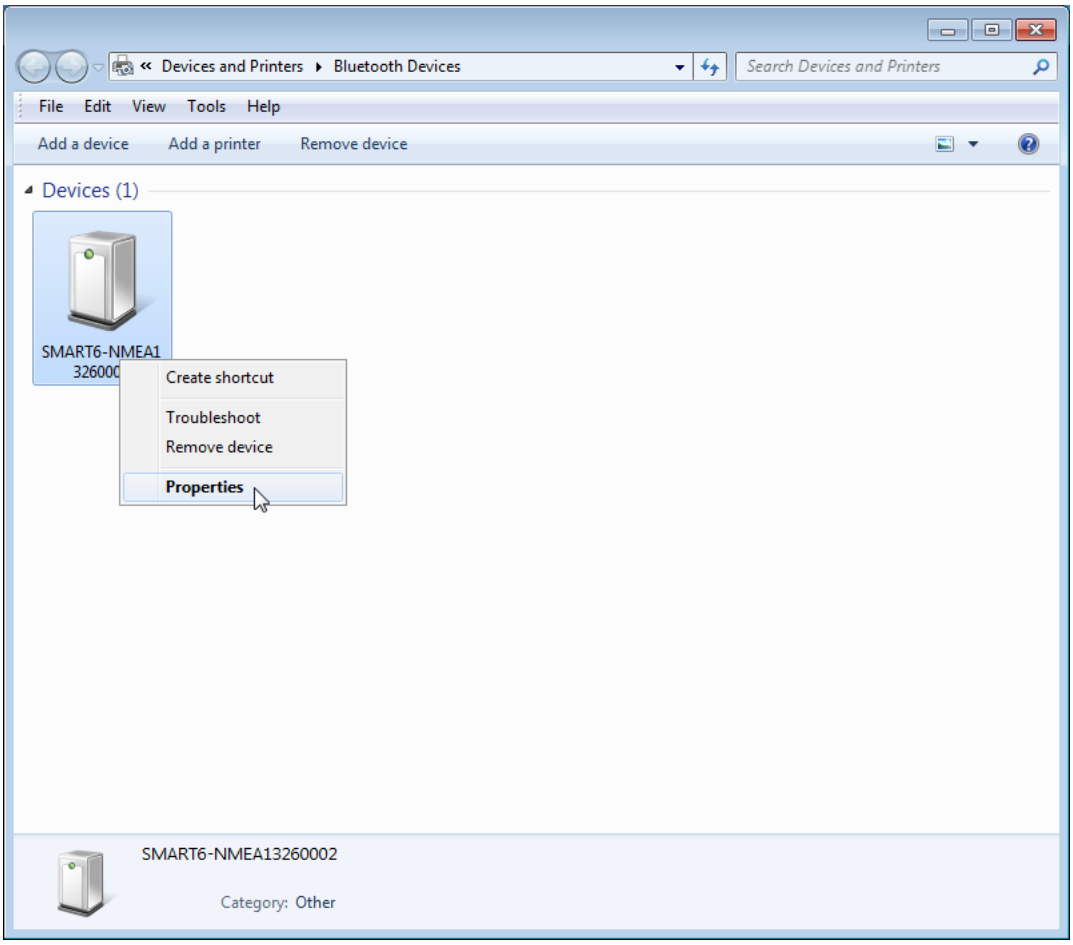
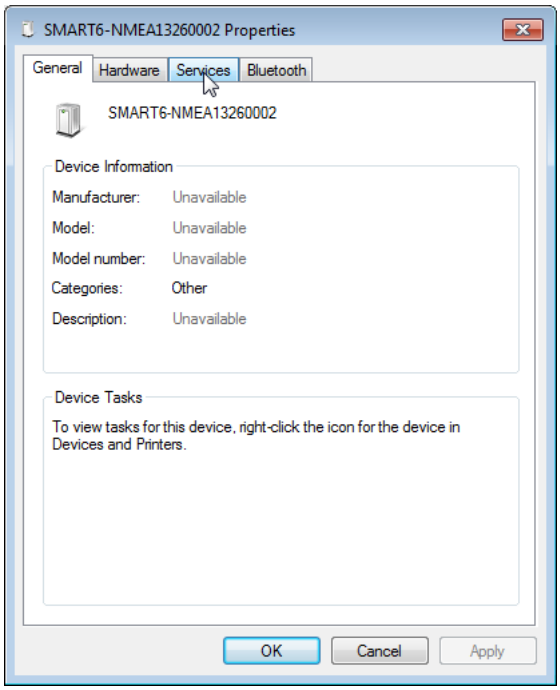
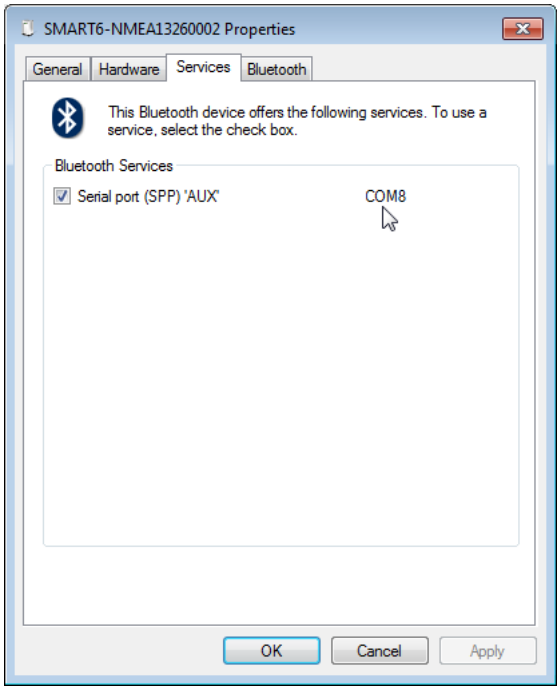


Figure 20: Bluetooth Devices Window - Properties



3. Click the *Services* tab. The Services tab displays the serial port information about the Bluetooth link to the SMART6. See *Figure 21* on page 37.

Figure 21: Properties - Services Tab



4.4 Communicate with the SMART6 Using *Bluetooth* Wireless Technology

1. Open a terminal program (HyperTerminal, for example) and configure it to the serial port assigned to the Bluetooth link. If you do not know the serial port information, see *Section 4.3, Determining the Bluetooth Serial Port* on page 34.
2. Configure the port settings as follows:

   115200 bps, no parity, 8 data bits, 1 stop bit, no handshaking, echo off
3. Through the terminal program, connect to the Bluetooth serial port and verify the connection.
4. Type the following VERSION log request into the command prompt to ensure that the connection works:

```
log version
```

Chapter 5 NovAtel Firmware and Software

Download the most recent versions of the NovAtel firmware and receiver software from the NovAtel website at www.novatel.com/support/firmware-downloads.

SMART6 Firmware and Software

Refer to *Section 5.3.1, Transferring Firmware Files on page 40* for descriptions of the Update and OEM versions.

NovAtel Connect PC Utilities Software Bundle

Bundled PC Utilities software includes:

- NovAtel Connect (a GUI interface)
- Connection Import (improves connection profiles)
- Convert (converts receiver data logs into different formats)
- USB Drivers and Window Signing

The NovAtel Connect PC Utilities bundle can be download from our web site: www.novatel.com/support/search/items/PC%20Software.

Firmware and Software included

- SoftLoad firmware
- WinLoad software utility

WinLoad and SoftLoad instructions follow.

5.1 Firmware Updates and Model Upgrades

A local NovAtel dealer can provide all the information needed to upgrade or update a receiver. Refer to www.novatel.com/where-to-buy for contact information or contact sales@novatel.com or support@novatel.com directly.

5.1.1 Firmware Updates

Firmware updates are firmware releases that include fixes and enhancements to the receiver functionality. Firmware updates are released on the NovAtel web site as they become available. New firmware must be loaded into the receiver through the COM1 or COM2 serial port. Once loaded, the receiver reboots and begins operating with the new firmware.

Direct access to the COM1 or COM2 serial port on the SMART6 receiver is required.

Firmware can not be loaded using the AUX port.

5.1.2 Model Upgrades

Model upgrades enable purchased receiver features.

Contact a local NovAtel dealer to assist in selecting the upgrade options that best suit your GNSS needs at www.novatel.com/where-to-buy. Contact NovAtel Customer Support www.novatel.com/support or NovAtel Sales to request a temporary upgrade authorization code for trial purposes.

The receiver stores the firmware in Non-Volatile Memory (NVM), which allows model upgrades to be performed without returning the receiver to the dealer. Model upgrades can be applied to the receiver with an authorization code and the AUTH command.

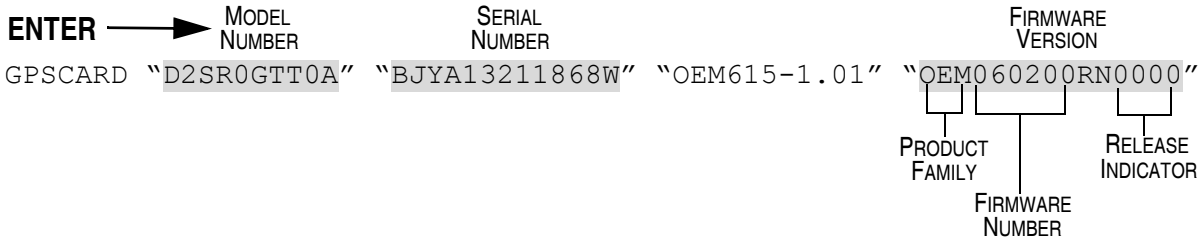
5.2 Authorization Code

An authorization code, commonly known as an auth-code, is required to upgrade and possibly update a SMART6 receiver. Auth-codes are obtained by contacting NovAtel Customer Support. Upon contact, NovAtel Customer Support requires:

- the receiver model number
- the receiver serial number
- the receiver firmware version

Enter the LOG VERSION command to determine the receiver model, serial number and firmware version.

Example:



After determining the appropriate model and firmware version the authorization code (auth-code) is issued. The auth-code is required to unlock the features on the new model type.

To upgrade to a new model with the same firmware version, use the AUTH command with the issued auth-code (if required), as outlined in *Upgrading Using the AUTH Command*.

To upgrade to a new model with a higher firmware version, the new firmware .shex file needs to be loaded into the SMART6 receiver using the WinLoad utility program. WinLoad and the firmware .shex files can be found at www.novatel.com/support/firmware-downloads. Refer to *Section 5.3, Updating or Upgrading Using the WinLoad Utility* on page 40 for use instructions.

Firmware version OEM060200RN0000 (also known as firmware version 6.200) and later contain the Firmware Signature feature. This firmware feature removes the authorization code dependency on the firmware version and eliminates the need to obtain an auth-code when downloading the latest version of signed firmware.

If updating from a version before 6.200 to a signed 6.200 version, an authorization code is required. The receiver must have boot version code 6.100 or later for signed firmware to work.

In version OEM060200RN0000, the receiver serial number and the software model are built into the signature in the firmware file. Once the 6.200 signed firmware is installed with a signature auth-code, future firmware updates no longer require a new unique auth-code.

> An authorization code is still required if the software model changes for temporary trial upgrades or purchased permanent upgrades.

The new download package includes a signed firmware file type that uses an extension designated as ".shex" (example OEM060200RN0000.shex), as well as the latest Winload utility and What's New file containing firmware update change details.

Prior to firmware version OEM060200RN0000, authorization codes depended on the software model, the firmware version and the serial number of the receiver. The authorization code changed if any of the three items changed. This is no longer the case.

5.3 Updating or Upgrading Using the WinLoad Utility

WinLoad is the simplest and most common way to update or upgrade a SMART6 receiver.

COM1 or COM2 must be used to update or upgrade a SMART6 receiver. The AUX port can not be used for loading firmware.

5.3.1 Transferring Firmware Files

To proceed with an update or possibly an upgrade, obtain the latest version of firmware from the NovAtel website at www.novatel.com/support/firmware-downloads.

Types of Firmware Files

- **OEM Version** - NovAtel Customer Service may generate and provide the required authorization code. Authorization codes are obtained by contacting support@novatel.com or at www.novatel.com/Support/.
  The OEM version is named OEMXXXX.EXE, where XXXX is the firmware version.

For convenience, copy the update file to a GNSS sub-directory (for example, C:\GNSS\LOADER).

If the firmware update file is password protected, NovAtel Customer Support provides the required password. After copying the file to a computer, perform the following steps to extract the files:

Syntax: [filename] [password] (if required)

where filename is the name of the compressed file (but not including the .EXE extension) and password if the password is required for extraction.

Example: OEM060200RN0000.shex

In the above example, a window appears asking for a password.

The self-extracting archive produces the following files:

winload.exe	WinLoad utility program
howto.txt	Instructions on how to use the WinLoad utility
whatsnew.rtf	Information on the changes made in the firmware since the last revision
x..x.shex	Firmware version upgrade file, where x..x defines the product name and release (e.g., OEM060000RN0000.shex)

The files are extracted to unzip/program files/NovAtel Inc/x.xxx Full Update Disk, where x.xxx is the firmware version.

NovAtel has an online video tutorial that explains firmware uploading at: www.novatel.com/support/search/items/Video.

SMART6 Application Software

The SMART6 receiver has two types of software loaded, the OEM6 firmware and the SMART6 Application Software. The OEM6 firmware provides the features that are common to all OEM6 receivers. The Application Software provides the special features available on the SMART6, such as Tilt Compensation and Emulated Radar.

The Application Software is available from the NovAtel website at www.novatel.com/support/firmware-downloads and is loaded onto the SMART6 receiver using the same procedures used for the OEM6 firmware. An authorization code is not required for Application Software updates.

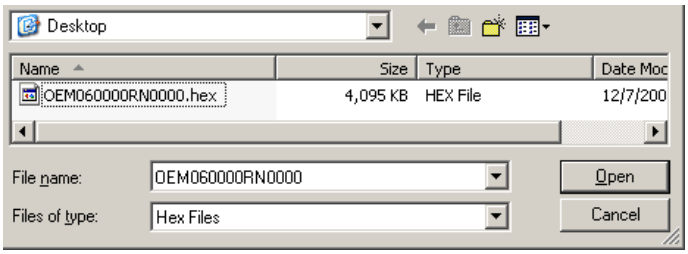
5.3.2 Using the WinLoad Utility

If opening WinLoad for the first time, ensure the file and communications settings are correct.

Open a File to Download

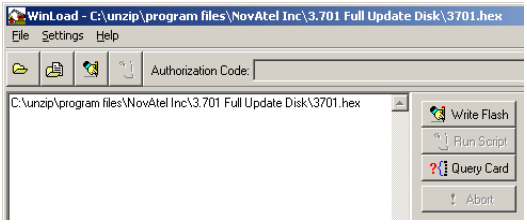
Select File |Open. Navigate to the file to open (*Figure 22)*.

Figure 22: WinLoad's Open Window



When a file is selected, the `filename` appears in the main WinLoad display area and in the title bar (*Figure 23).*

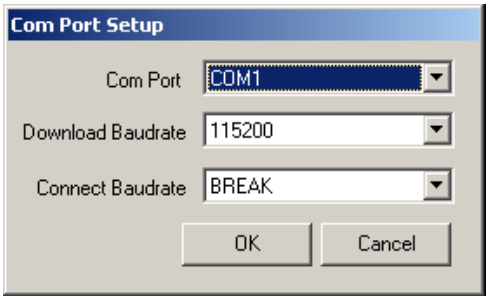
Figure 23: Open File in WinLoad



Communications Settings

To set the communications port and baud rate, select Settings | COM Settings. Choose the computer port to use from the Com Port drop down list and the baud rate from the Download Baudrate drop down list. Set the baud rate as high as possible (the default of 115200 is preferred if a higher baud rate is not available).

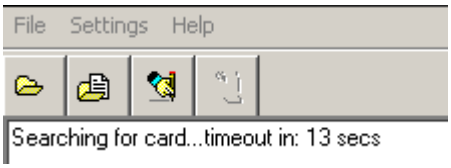
Figure 24: COM Port Setup



Downloading Firmware

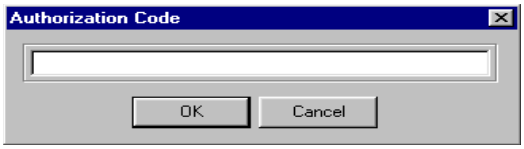
1. Select the file to download according to *Open a File to Download on Page 41*.
2. Ensure the file path and name are displayed in main display area (see *Figure 23, Open File in WinLoad on page 41*).
3. Click Write Flash to download the firmware.
4. When `Searching for card` appears in the main display, power cycle the receiver.

Figure 25: Searching for Card



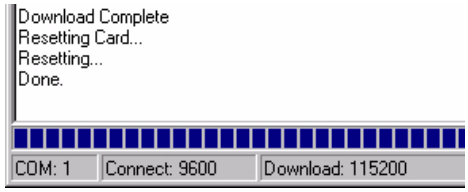
5. If the Authorization Code window appears, enter the auth-code and click **OK**. See *Section 5.2, Authorization Code on page 39* for further information about the Authorization Code.

Figure 26: Authorization Code Window



6. The receiver finishes the download and then resets. The process is complete when `Done` appears in the main display area.

Figure 27: Upgrade Process Complete



7. Close WinLoad.

5.4 Updating using SoftLoad Commands

To use Softload to update a SMART6 family receiver.

Use SoftLoad if automated loading is required or the platform used to communicate with the receiver is not supported by WinLoad.

Refer to *Types of Firmware Files on page 40* for details on updating versus upgrading.

1. Open a connection to any port on the receiver.
2. Request the SOFTLOADSTATUSA log using the following command:
   `LOG SOFTLOADSTATUSA ONCHANGED`
3. Initialize SoftLoad with a `SOFTLOADRESET` command. This command stops all tracking on the receiver to ensure sufficient memory is available for the loading process. A RXSTATUSEVENTA log reports a SoftLoad In Progress status.

4. Open the *.shex firmware file.

> If using NovAtel Connect, close all windows before using the SOFTLOADSREC command to avoid failure. Only the Console and ASCII Message windows may remain open.

5. Send each line of the *.shex file to the receiver in a SOFTLOADSREC command. The S-Records must be enclosed by quotation marks:
SOFTLOADSREC "<S-RECORD>"

> To significantly decrease data transfer time, NovAtel recommends creating a batch file to automatically send each line of SOFTLOADSREC. Contact NovAtel Customer Support for assistance creating SoftLoad batch files.

6. Send the SOFTLOADCOMMIT command.
7. During the loading process, SOFTLOADSTATUSA logs report the load status. Wait for the SOFTLOAD-STATUSA to indicate loading is complete.

> Signature auth-codes are maintained internally by the receiver and do not need to be r e-entered. Refer to *Section 5.2, Authorization Code on page 39* for details on obtaining any auth-code.

8. Reset the receiver by entering RESET or FRESET command or power cycling.
9. Once the receiver resets, the new version of firmware is active.

> The SoftLoad process can be cancelled safely at any time during the process using the RESET command.

5.4.1 Working with S-Records

- Records beginning with S0, S5 and S7 should be passed to the receiver directly using the SOFTLOADSREC command. These records contain meta data about the firmware image.
- Records beginning with S3 form the actual firmware image and can be converted to SOFTLOADDATA binary commands. Aside from the header, each pair of characters forms the ASCII representation of binary byte. The format is as follows:

S3	LL	AAAAAAAA	DDDDDDDD...DDDDDDDD	CC
Header	Length.This is the hexadecimal number of character pairs to follow in the record. This value minus 4 bytes for the address and 1 byte for the check sum is copied into the "data length" field of the SOFTLOADDATA command	4 - Byte Address. Set this as the value of "offset" in the SOFTLOADDATA command	Little Endian Data. These bytes are copied into the "data" field of the SOFTLOADDATA command	Check Sum. One's compliment of all other bytes

- Multiple S3 records can be packaged into a single SOFTLOADDATA command as long as the data from one S3 record follows immediately after the previous record, up to a maximum of 4096 bytes of data. That is, the address must equal the previous address plus the previous data length. The "offset" field remains the address of the first S3 record and the "data" and "data length" are updated to include the new data.
- The shex file data may contain many gaps and jumps. For example, in most NovAtel shex files data for address 0x000_00000 is stored near the very end of the file.

5.5 Upgrading Using the AUTH Command

The AUTH command authorizes the enabling (unlocking) of model features. The AUTH command is used to upgrade a new SMART6 model, available with the same firmware version as the current model. This command only functions with a valid auth-code assigned by NovAtel Customer Support.

The upgrade can be performed directly through the NovAtel Connect command line or from any other communications program.

5.5.1 Upgrade Procedure

1. Power up the SMART6 receiver and establish communications (refer to the Quick Start Guide included with the product for instructions).
2. Issue the LOG VERSION command to verify the current model, firmware version and serial number (refer to *Section 5.2, Authorization Code on page 39* for instructions on obtaining).
3. Issue the AUTH command, followed by the auth-code and model type (refer to *Section 5.2, Authorization Code on page 39* for details on obtaining any auth-code). The syntax is as follows:

```
auth <your auth-code here>
```

where auth is a command that enables model upgrades and auth-code is the upgrade authorization code, expressed as follows:

XXXXXX,XXXXXX,XXXXXX,XXXXXX,XXXXXX,MODEL,EXPDATE

where:

1. Each X character is a case-insensitive ASCII character.
2. The MODEL string is a maximum of 15 characters long and represents the model enabled by the auth-code.
3. The EXPDATE string is the auth-code's expiry date, in YYMMDD format

Example:

```
auth 7WBMBK,887CB6,K5J3FH,5DF5P2,42PW8G,D1SB0GTT0,121211
```

When the AUTH command is executed, the SMART6 receiver reboots. Issuing the LOG VERSION command confirms the new upgrade model type and firmware version number.

If communicating using NovAtel Connect, the communication path must be closed and reopened using the Device menu.

Appendix A Technical Specifications

A.1 SMART6 Receiver Performance

PERFORMANCE[a]			
Channel Configuration	120 Channels can be configured to track: L1 GPS L2 GPS (optional) L2C GPS (optional) L1 GLONASS (optional) L2 GLONASS (optional) Galileo E1 (optional) BeiDou B1 (optional) SBAS[b]		
Horizontal Position Accuracy (RMS)[c]	Single Point	1.5 m	
	Single Point L1/L2	1.2 m	
	SBAS[c]	0.6 m	
	DGPS	0.4 m	
	RT-2™	1 cm + 1 ppm	
Measurement Precision (RMS)		**GPS**	**GLO**
	L1 C/A code	4 cm	15 cm
	L1 carrier phase	0.5 mm	1.5 mm
	L2 P(Y) code[d]	8 cm	8 cm
	L2 carrier phase[d]	1 mm	1.5 mm
	L2C code[e]	8 cm	8 cm
	L2C carrier phase[e]	0.5 mm	1.5 mm
Maximum Data Rate[f]	Measurements	up to 20 Hz	
	Position	up to 20 Hz	
Time to First Fix	Cold Start[g]	<50 s	
	Hot Start[h]	<35 s	
Signal Reacquisition	L1	0.5 s (typical)	
	L2	<1.0 s (typical)	
Time Accuracy	20 ns RMS		
Velocity Accuracy[i]	0.03 m/s RMS		

a. Typical values. Performance specifications subject to GPS system characteristics, US DOD operational degradation, ionospheric and tropospheric conditions, satellite geometry, baseline length, multipath effects and the presence of intentional or unintentional interference sources.
b. Satellite Based Augmentation Systems (SBAS) include WAAS (North America), EGNOS (Europe) and MSAS (Japan).
c. GPS only.
d. L2 P for GLONASS.
e. L2 C/A for GLONASS.
f. Model specific.
g. Typical value. No almanac or ephemerides and no approximate position or time.
h. Typical value. Almanac and recent ephemerides saved and approximate time entered. For more information, refer to the "SETAPPROXTIME" command in the OEM6 Family Firmware Reference Manual found on our web site at www.novatel.com/support/manuals/.
i. Export licensing restricts operation to a maximum velocity of 515 metres per second.

A.2 SMART6 Specifications

INPUT/OUTPUT CONNECTORS	
SMART6 Communication/Power	+8 to +36 V DC at 3.5 W [a] For the cable pinouts and drawings, see *Section A.2.1, SMART6 Communication/Power Cable (01018999)* on page 49
Serial Com Ports	RS-232 F Compliant (Rx and Tx signals only)
CAN	SAE J1939/ ISO 11783/ ISO 11898 Compatible
Emulated Radar Output	High = Supply Voltage -0.5V Minimum Low = 0.5V Maximum Load = 3K Ohm Minimum
PPS Output	3.3 V CMOS Logic Compatible
MKI Input	3.3 V CMOS Logic/5 V Tolerant
INPUT/ OUTPUT CONNECTOR PROTECTION	
Electrical Conducted/ Coupled disturbance tolerance	ISO 7637-2:2004 Functional Class A: Pulses 2a, 3a, 3b, 4 Functional Class C: Pulses 1, 2b
LED INDICATORS	
Power, Error and Position Valid	Refer to *Section 2.2.1, Status Indicators* on page 17 for details
PHYSICAL	
Size	80.9 x ϕ155 mm[b]
Weight	<520 g
Mounting	2 x magnetic mount
	4 x M4 screw inserts
	Optional mounting plate
ENVIRONMENTAL [c]	
Operating Temperature	-40°C to +70°C
Storage Temperature	-55°C to +90°C
Humidity	MIL-STD-810G Method 507.5
Immersion	MIL-STD-810G Method 512.5 Procedure 1
Shock	MIL-STD-810G Method 516.6
Solar Radiation	MIL-STD-810G Method 505.5
Salt Fog	MIL-STD-810G, Method 509.5
Sand and Dust	MIL-STD-810G, Method 510.5
ENVIRONMENTAL [c]	
Vibration	Random: MIL-STD-810G, Method 514.6 (tailored to 5.3 g) Sinusoidal: ASAE EP455, Section 5.15.2 Level 1 & 2
Compliance	FCC, IC, CE
Ingress Protection Rating	IP67

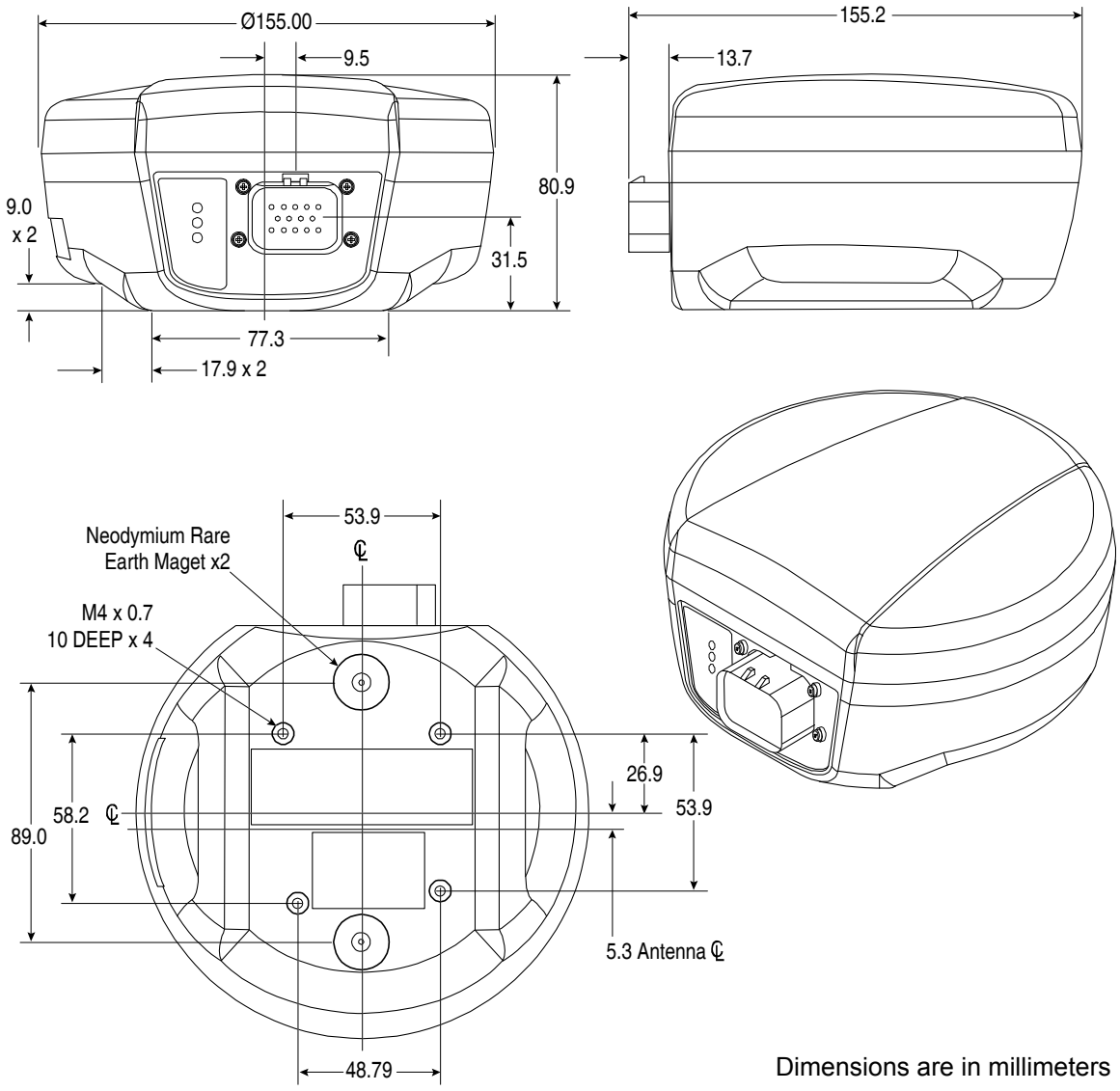
INPUT/OUTPUT DATA INTERFACE	
COM1	
Electrical format	RS-232
Bit rates (bps)	2400, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400, 460800 or 921600
Signals supported	TxD1, RxD1
Flow control	XON/XOFF
Features supported	Logs, Commands, Firmware Upgrade, NovAtel Connect, Baud rate reset using Break
COM2	
Electrical format	RS-232
Bit rates (bps)	2400, 4800, 9600 (default), 19200, 38400, 57600, 115200, 230400, 460800 or 921600
Signals supported	TxD2, RxD2
Flow control	XON/XOFF
Features supported	Logs, Commands, Firmware Upgrade, NovAtel Connect, Baud rate reset using Break
AUX	
Electrical format	RS-232
Bit rates (bps)	2400, 4800, 9600 (default), 19200, 38400, 57600 or 115200
Signals supported	TxD1, RxD1
Flow control	Not supported
Features supported	Logs, Commands, NovAtel Connect (passive connection only)
AUX (with Bluetooth Option)	
Electrical format	Bluetooth Serial Port
Bit rates (bps)	115200 (fixed)
Signals supported	TxD1, RxD1
Flow control	Not supported
Features supported	Logs, Commands, NovAtel Connect (passive connection only)

a. Power consumption values for GPS L1/L2.

b. ϕ denotes diameter, here and in the *Dimensions* graphic on *page 48.*

c. See also the *Notice* section of this manual starting on *page 9.*

Figure 28: SMART6 Dimensions



Dimensions are in millimeters

A.2.1 SMART6 Communication/Power Cable (01018999)

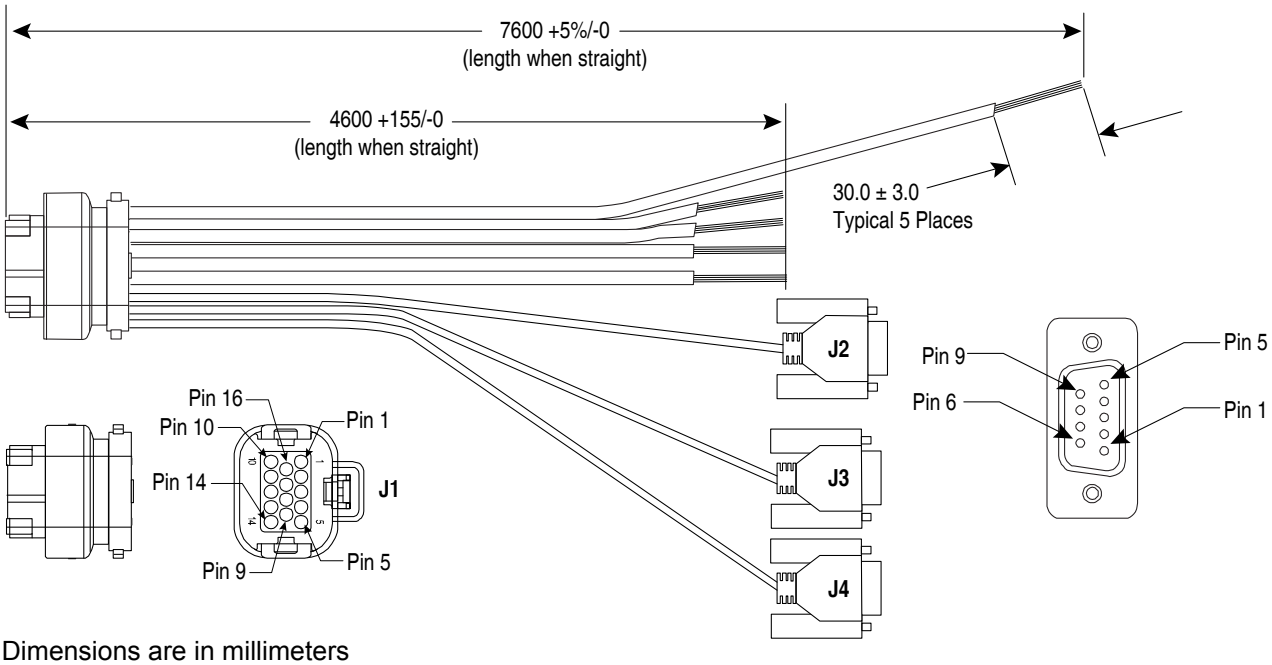
The SMART6 cable (refer to *Figure 29, SMART6 Communication/Power Cable*), provides a means of supplying power from a battery while operating in the field. The exposed wires (red for positive and black for negative) can then be connected to a vehicular power circuit (or equivalent) protected by a 5 A fast blow fuse (user supplied). The cable has three DB-9 connectors to accommodate a computer serial (RS-232) communication port, a modem or radio transmitter to propagate differential corrections (refer to the user supplied modem or radio transmitter user guide for information on its connectors).

Bluetooth wireless technology uses the AUX port. When Bluetooth wireless technology is enabled, AUX is not available on the SMART6 connector or the cable.

In addition, there are a number of bare wires where the outer insulation is cut away but the wires beneath remain intact. See *Table 5, SMART6 Communication/Power Cable Pinouts* on page 50 for their pinouts. For more information on mating connectors and part numbers, see *Table 6, SMART6 Mating Connectors* on page 51.

This cable is RoHS compliant.

Figure 29: SMART6 Communication/Power Cable



Dimensions are in millimeters

The SMART6 Communication/Power Cable (01018999) is intended for use with both the SMART6 and the SMART6-L receivers. On the SMART6, the DB9 connector labelled COM3 (J4) is used for the AUX port.

Table 5: SMART6 Communication/Power Cable Pinouts

Signal Name	J1	J2	J3	J4	Label
COM1_TXD	1	2			
COM1_RXD	2	3			
COM2_TXD	3		2		
COM2_RXD	4		3		
AUX_TXD	8			2	
AUX_RXD	13			3	
COM1 GND	5	5			
COM2 GND			5		
AUX GND				5	
EVENT MARK IN (MKI) GND					MKI GND
Emulated Radar GND					ER GND
Pulse Per Second GND					PPS GND
CAN+	6				CANI+
CAN-	7				CANI-
PWR RET (GND)	9				BATT-
Emulated Radar Out	10				ER_OUT
EVENT MARK IN (MKI)	11				MKI
PPS	12				PPS
PWR INPUT	14				BATT+

A.2.2 SMART6 Connector and Cable Requirements

Custom cables for installing the SMART6 can be created using the following guidelines:

- Wire size: must be 0.5 mm-1.25 mm (20-16 AWG)
- Batt+ connection must be protected by 5 A fast blow fuse
- Serial data signals (TxD, RxD, signal ground) must be run in shielded cable. Connect shields to ground at SMART6 end only
- CAN signal conductors must be twisted (40 twists/m, 12 twists/ft)
- Use only the recommended mating connectors listed below. Use only gold plated pins

Failure to observe the given cable construction guidelines and fusing requirements in this section may result in damage to the wiring or equipment and voiding the warranty.

NovAtel recommends tying to ground any floating input lines.

The connector used in the SMART6 is an “AMPSEAL” dust and water sealed type produced by Tyco. The following part numbers pertain to the mating connector required to make connections to the SMART6. These numbers are provided for information only and are not available from NovAtel as separate parts.

Table 6: SMART6 Mating Connectors

Product	Part Description	Company	Part Number
SMART6 mating connector (J1 - *Figure 29* on *page 49*)	14-pin sealed receptacle housing-black	Tyco/AMP	776273-1
Gold plated pins (20-16 AWG) for (J1) SMART6 connector	Pins, loose piece	Tyco/AMP	770854-3
Gold plated pins for SMART6 connector/strip	Pins, strip (reel)	Tyco/AMP	770520-3
Seal Plug for unused pins on mating connector. (All connector positions must be populated with a pin or seal plug to achieve the IP-67 rating for the cable connection.)	Seal plug	Tyco/AMP	770678-1

Table 7 details the part numbers for recommended fuses and fuse holders. These numbers are provided for information only and are not available from NovAtel as separate parts.

Table 7: Recommended Fuse and Fuse Holders

Fuse	Recommended Fuse/Fuse Holder		
12 V System Fuse (standard size blade)	ATO Silver Blade Fuse 5 A (32 V)	Littelfuse	0287005
	Or Equivalent		
12 V System Fuse (mini size blade)	Mini Blade Fuse 5 A (32 V)	Littelfuse	0297005
	Or Equivalent		
12 V System Fuse High Reliability, Harsh Environment (standard size blade)	FKS ATO Blade Fuse 5A (80 V)	Littelfuse	166.7000.450
	Or Equivalent		
Inline Fuse Holder, (for standard size blade)	Waterproof ATO Fuse Holder	Littelfuse	FHAC0001
	Or Equivalent		
Inline Fuse Holder, (for mini size blade)	Waterproof Mini Fuse Holder	Littelfuse	0FHM0001
	Or Equivalent		

Appendix B Commands

The SMART6 firmware implements the OEM6 family command set, documented in the OEM6 Family Firmware Reference Manual. Commonly used SMART6 commands are summarized in *Table 8, SMART6 Commands* and documented in this appendix.

Table 8: SMART6 Commands

ASCII Command	Message ID	Description
BTCONTROL	8205	Enable or disable Bluetooth wireless technology.
FRESET	20	Factory reset (existing OEM6 commands extended to SMART6)
LOG	1	Request logs from the receiver
$PMDT	8200	Configure the Tilt Compensation function (SMART6 command)
RADARCFG	8192	Configure the Emulated Radar signal output (SMART6 command)
SERIALCONFIG	1246	Configure the receiver serial port settings.
SETCANNAME	1091	Set the CAN name fields.

The arguments for each of these commands are described in the following sections.

For a complete listing and description of the other commands that the SMART6, an OEM6 based receiver, is capable of processing, refer to the OEM6 Family Firmware Reference Manual.

B.1 SYNTAX CONVENTIONS

The following rules apply when entering commands, at the command prompt, from a keyboard.

1. `Courier` font is used to illustrate program output or user input.
2. References to other commands, logs or any of their fields are shown in *italics*.
3. The commands are not case sensitive. For example, you could type either `RESET` or `reset`.
4. Except where noted, either a space or a comma can separate commands and their required entries. For example, you could type either `fix position 51.11358042 -114.04358013 1059.4105` or `fix position 51.11358042, -114.04358013, 1059.4105`.
5. At the end of a command, a carriage return is required. For example, press <Enter> or <Return> on your keyboard.
6. Responses are provided to indicate whether or not an entered command was accepted. The format of the response depends on the format of the command. Refer to the OEM6 Family Firmware Reference Manual for more information.
7. Optional parameters are indicated by square brackets (`[ ]`). For commands that contain optional parameters, the value used if the optional parameter is not specified is given in the syntax table for the command.
8. Data format definitions, as specified in the “Format” field, are detailed in the OEM6 Family Firmware Reference Manual. Note that all binary data is little-endian byte-ordered.

B.2 BTCONTROL Enable/Disable Bluetooth wireless technology

The BTCONTROL command enables or disables the Bluetooth module.

Message ID: 8205

Abbreviated ASCII Syntax:

```
BTCONTROL switch
```

Factory Default:

The *Bluetooth* module is enabled by default.

Example 1 to disable Bluetooth wireless technology:

```
btcontrol disable
```

Example 2 to enable Bluetooth wireless technology:

```
btcontrol enable
```

Field	Data	Description	Binary Bytes	Binary Format	Binary Offset
1	BTCONTROL header	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary.	-	-	0
2	switch	Enable or disable *Bluetooth* wireless technology 0 = ENABLE 1 = DISABLE (default = ENABLE)	4	Enum	H

1. To enable the current state of the Bluetooth module to persist across receiver resets and power-ups, issue a *SAVECONFIG* command.
2. Changing the Bluetooth wireless technology from disabled to enabled takes several seconds to execute. This means that, even though the user will get an immediate “OK>” response followed by the COM prompt, the Bluetooth module may not be ready for communication.

B.3 COM Configure COM Port

The SERIALCONFIG command replaces the COM command (see page 62).

B.4 FRESET Clear Selected Data from NVM and Reset

This command clears data that is stored in non-volatile memory. Such data includes the almanac, ephemeris and any user specific configurations. The commands, ephemeris and almanac related data can be cleared by using the `STANDARD` target. The model can only be cleared by using the `MODEL` target. The receiver is forced to hardware reset. In addition, values entered using the `CLOCKCALIBRATE` command can only be cleared by using the `CLKCALIBRATION` target.

Issuing the FRESET command affects Tilt as follows:

- Tilt sensor level is restored to the factory default
- Tilt enable/disable is not be affected

> `FRESET STANDARD` (which is also the default) causes any commands, ephemeris, GNSS and almanac data previously saved to NVM to be erased.

Message ID: 20

Abbreviated ASCII Syntax:

```
FRESET [target]
```

Input Example:

```
FRESET COMMAND
```

> If you are receiving no data or random data from your receiver, try the following before contacting NovAtel:
>
> - Verify that the receiver is tracking satellites
> - Check the integrity and connectivity of power and data cables
> - Verify the baud rate settings of the receiver and terminal device (your computer or data logger)
> - Switch COM ports
> - Issue a FRESET command

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FRESET header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary.	-	H	0
2	target	See *Table 9, FRESET Target* on *Page 56*		What data is to be reset by the receiver. (default=STANDARD)	Enum	4	H

Table 9: FRESET Target

Binary	ASCII	Description
0	STANDARD	Resets commands, ephemeris and almanac (default).
1	COMMAND	Resets the stored commands (saved configuration)
2	GPSALMANAC	Resets the stored GPS almanac
3	GPSEPHEM	Resets the stored GPS ephemeris
4	GLOEPHEM	Resets the stored GLONASS ephemeris
5	MODEL	Resets the currently selected model
10	USERDATA	Resets SMART6 only commands
11	CLKCALIBRATION	Resets the parameters entered using the `CLOCKCALIBRATE` command
20	SBASALMANAC	Resets the stored SBAS almanac
21	LAST_POSITION	Resets the position using the last stored position
31	GLOALMANAC	Resets the stored GLONASS almanac
52	PROFILEINFO	Resets the stored profile configurations

B.5 LOG Request Logs from the Receiver

Many different types of data can be logged using several different methods of triggering the log events. Every log element can be directed to any combination of the three COM ports. The ONTIME trigger option requires the addition of the *period* parameter. See the OEM6 Family Firmware Reference Manual for further information and a complete list of data log structures. The *LOG* command tables in this section show the ASCII command format.

The optional parameter [hold] prevents a log from being removed when the `unlogall` command, with its defaults, is issued. To remove a log that was invoked using the [hold] parameter requires the specific use of the `unlog` command. To remove all logs that have the [hold] parameter, use the `UNLOGALL` command with the *held* field set to 1.

The [port] parameter is optional. If [port] is not specified, [port] is defaulted to the port that the command was received on.

1. The OEM6 family of receivers can handle 64 logs at a time. If it is more than 64 logs at a time, the receiver responds with an Insufficient Resources error.
2. Maximum flexibility for logging data is provided to the user by these logs. The user is cautioned, however, to recognize that each log requested requires additional CPU time and memory buffer space. Too many logs may result in lost data and degraded CPU performance. Receiver overload can be monitored using the idle time field and buffer overload bits of the Receiver Status in any log header.
3. Polled log types do not allow fractional offsets or ONTIME rates faster than 1 Hz.
4. Use the ONNEW trigger with the MARKTIME or MARKPOS logs.
5. Only the MARKPOS or MARKTIME logs and 'polled' log types are generated, on the fly, at the exact time of the mark. Synchronous and asynchronous logs output the most recently available data.
6. If the ONTIME trigger is used with asynchronous logs, the time stamp in the log does not necessarily represent the time the data was generated but rather the time when the log is transmitted.

Message ID: 1

Abbreviated ASCII Syntax:

```
LOG [port] message [trigger [period [offset [hold]]]]
```

Abbreviated ASCII Example 1:

```
LOG COM1 BESTPOS ONTIME 7 0.5 HOLD
```

The above example shows BESTPOS logging to COM port 1 at 7 second intervals and offset by 0.5 seconds (output at 0.5, 7.5, 14.5 seconds and so on). The [hold] parameter is set so logging is not disrupted by the `unlogall` command.

To send a log only one time, the trigger option can be ignored.

Abbreviated ASCII Example 2:

```
LOG COM1 BESTPOS ONCE 0.000000 0.000000 NOHOLD
```

Refer to the *Command Formats* section of the OEM6 Family Firmware Reference Manual for additional examples.

1. In NovAtel Connect there are two ways to initiate data logging to the receiver's serial ports:
   - the `LOG` command in the *Console* window or
   - use the interface provided in the *Logging Control* window.
2. Only the ASCII/Abbreviated ASCII log table is included in this manual. Refer to the `LOG` command in the OEM6 Family Firmware Reference Manual for binary log details.

Factory Default:

```
LOG COM1 RXSTATUSEVENTA ONNEW 0 0 HOLD
LOG COM2 RXSTATUSEVENTA ONNEW 0 0 HOLD
LOG AUX RXSTATUSEVENTA ONNEW 0 0 HOLD
```

Field	Field Name	ASCII Value	Description	Field Type
1	LOG (ASCII) header	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII or ASCII respectively	-
2	port	See *Table 10, Detailed Serial Port Identifiers* on page 59	Output port (default = THISPORT)	Enum
3	message	Any valid message name, with an optional A or B suffix	Message name of log to output	Char [ ]
4	trigger	ONNEW	Output when the message is updated (not necessarily changed)	Enum
		ONCHANGED	Output when the message is changed	
		ONTIME	Output on a time interval	
		ONNEXT	Output only the next message	
		ONCE	Output only the current message (default)	
		ONMARK	Output when a pulse is detected on the mark 1 input, MK1I	
5	period	Any positive double value larger than the receiver's minimum raw measurement period	Log period (for ONTIME trigger) in seconds (default = 0)	Double
6	offset	Any positive double value smaller than the period	Offset for period (ONTIME trigger) in seconds. To log data at 1 second after every minute, set the period to 60 and the offset to 1 (default = 0)	Double
7	hold	NOHOLD	Allow log to be removed by the UNLOGALL command (default)	Enum
		HOLD	Prevent log from being removed by the UNLOGALL command	

Table 10: Detailed Serial Port Identifiers

ASCII Port Name	Hex Port Value	Decimal Port Value [a]	Description
NO_PORTS	0	0	No ports specified
COM1_ALL	1	1	All virtual ports for COM port 1
COM2_ALL	2	2	All virtual ports for COM port 2
THISPORT_ALL	6	6	All virtual ports for the current port
ALL_PORTS	8	8	All virtual ports for all ports
XCOM1_ALL	9	9	All virtual COM1 ports
XCOM2_ALL	a	10	All virtual COM2 ports
AUX_ALL	10	16	All virtual ports for the AUX port
COM1	20	32	COM port 1, virtual port 0
COM1_1	21	33	COM port 1, virtual port 1
...			
COM1_31	3f	63	COM port 1, virtual port 31
COM2	40	64	COM port 2, virtual port 0
...			
COM2_31	5f	95	COM port 2, virtual port 31
THISPORT	c0	192	Current COM port, virtual port 0
THISPORT_31	df	223	Current COM port, virtual port 31
XCOM1	1a0	416	Virtual COM1 port, virtual port 0
XCOM1_1	1a1	417	Virtual COM1 port, virtual port 1
...			
XCOM1_31	1bf	447	Virtual COM1 port, virtual port 31
XCOM2	2a0	672	Virtual COM2 port, virtual port 0
XCOM2_1	2a1	673	Virtual COM2 port, virtual port 1
...			
XCOM2_31	2bf	703	Virtual COM2 port, virtual port 31
AUX	8a0	2208	AUX port, virtual port 0
...			
AUX_31	8bf	2239	AUX port, virtual port 31

a. Decimal port values 0 through 16 are only available to the `UNLOGALL` command and cannot be used in the `UNLOG` command or in the binary message header.

For detailed information on virtual ports, refer to the `LOG` command in the OEM6 Family Firmware Reference Manual.

B.6 $PMDT Configure Tilt Compensation

Use this NMEA command to configure the Tilt Compensation function.

Syntax

```
$PMDT,[command],[parameters]*cksum
```

Host	Description	Command Format	Tilt Sensor Response
u[a] [b]	Set GPS Sensor Height	To set the GNSS sensor height in feet and inches: $PMDT,u,,ff,ii*cksum <cr><lf> Example: To set the GNSS sensor height to 12 ft 6 in, the command is: $PMDT,u,,12,6*4D **Note**: Feet and inches are entered as integers. You can enter feet and inches, but not feet, inches and metres.	Response to the "u" command: $PMDT,<,GNSS sensor height (inches):nnnnn <cr><lf> where nnnnn is a five digit integer, sensor height in inches. In this example, the Tilt Sensor response is: $PMDT,<,GNSS sensor height (inches): 00150
		To set the GNSS sensor height in metres: $PMDT,u,,,,mmm.mmm*cksum <cr><lf> Example: To set the GNSS sensor height to 3.5 metres, the command is: $PMDT,u,,,,3.5*7C	Response to the "u" command: $PMDT,<,GNSS sensor height (inches):nnnnn <cr><lf> where nnnnn is a five digit integer, sensor height in inches. In this example, the Tilt Sensor response is: $PMDT,<,GNSS sensor height (inches): 00137
l	Set Field Level	$PMDT,l*cksum <cr><lf> Example: $PMDT,l*4D	Response to the "l" command: $PMDT,<,Level state set <cr><lf> Example: $PMDT,<,Level state set
x	Update Flash Values	To update flash values (needs to follow any height or level command that is not done each time you power up): $PMDT,x*cksum <cr><lf> Example: $PMDT,x*59 **Note**: The command `$PMDT,x*59` must be used to save the $PMDT settings to memory. The SAVECONFIG does not save $PMDT settings.	Response to the "x" command: $PMDT,<,Flash updated <cr><lf> Example: $PMDT,<,Flash updated

a. If all fields in the u command are zero or null, the current height is transmitted without change (with the format shown above). Use the following command to return the current settings: `$PMDT,u*54`.

b. If an invalid entry is received (>500 inches), the response is:

```
$PMDT,<Max legal height exceeded: nnnnn and will be ignored
```

For example, if you enter 42 ft 6 in, you will get the following response:

```
$PMDT,<,Max legal height exceeded: 00510 and will be ignored
$PMDT,<,GPS sensor height (inches): 00150
```

Refer to *Tilt Compensation* on page 18 and *Tilt Compensation* on page 29 for setup instructions.

B.7 RADARCFG Configure the ER Output

Use this command to configure the Emulated Radar (ER) output. ER is available through the SMART6 interface cable, see *Table 5, SMART6 Communication/Power Cable Pinouts* on page 50 for pin-out details.

Message ID: 8192

Syntax

```
radarcfg switch freq_step update_rate resp_mode threshold
```

Field	Data	Description	Bytes	Format	Units	Offset
1	Header	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary.		-	-	0
2	switch	Enable or disable radar emulation 0 = ENABLE 1 = DISABLE (default = enable)	4	Enum	none	H
3	freq_step	Frequency step per kilometer per hour. Range: 26.11, 28.12 or 36.11 (default = 36.11)	8	Double	Hz/kph	H+4
4	update_rate	Specify how often to update radar output Range: 1, 2, 5, 10, 20 (default = 10)[a]	4	Integer	Hz	H+12
5	resp_mode	Specify the time response mode, over which to average velocity samples, see *Table 11, Response Modes.* (Default = 500)[a]	4	Integer	none	H+16
6	threshold	The threshold is only applicable when the response mode is set to 2. The response time is 1000 ms when the velocity is greater than this value, otherwise, it is 500 ms. Range: 2-50 kph (default = 5 kph)	8	Double	kph	H+20

a. The number of samples used for smoothing depends on both the update_rate and resp_mode parameters. For instance, if the update_rate is 5 Hz and the resp_mode is 2000ms, the number of samples used will be 10.

Table 11: Response Modes

Mode	Description	
2000	2000 ms	The time period over which to smooth velocity samples
1000	1000 ms	
500	500 ms (default)	
2	Automatically switches between 1000 and 500 ms	
1	Performs no smoothing	

Example 1 to disable radar emulation: `radarcfg disable 26.11 1 1 2`

Example 2 to set the frequency step to 36.11 Hz/kph, update rate to 1 Hz and no smoothing: `radarcfg enable 36.11 1 1 2`

B.8 SERIALCONFIG Configures serial port settings

1. This replaces the COM command.
2. The SERIALCONFIG command can be used as a log to confirm settings.
3. The entire content of the current log is sent before pausing due to the receipt of the XOFF character.

This command is used to configure the receiver's asynchronous serial port communications drivers.

The current SERIALCONFIG port configuration can be reset to its default state at any time by sending it two hardware break signals of 250 milliseconds each, spaced by fifteen hundred milliseconds (1.5 seconds) with a pause of at least 250 milliseconds following the second break. This will:

- Stop the logging of data on the current port (see the UNLOGALL command in the OEM6 Family Firmware Reference Manual)
- Clear the transmit and receive buffers on the current port
- Return the current port to its default settings
- Set the interface mode to NovAtel for both input and output (see the INTERFACEMODE command in the OEM6 Family Firmware Reference Manual).

The AUX port does not support break detection. This applies to models with Bluetooth and without Bluetooth.

1. The COMCONTROL command, may conflict with handshaking of the selected COM port. If handshaking is enabled, then unexpected results may occur.
2. Baud rates higher than 115,200 bps are not supported by standard PC hardware. Special PC hardware may be required for higher rates, including 230400 bps, 460800 bps and 921600 bps. Also, some PC's have trouble with baud rates beyond 57600 bps. Watch for situations where the COM ports of two receivers are connected together and the baud rates do not match. Data transmitted through a port operating at a slower baud rate may be misinterpreted as break signals by the receiving port if it is operating at a higher baud rate. This is because data transmitted at the lower baud rate is stretched relative to the higher baud rate. In this case, configure the receiving port to have break detection disabled using the SERIALCONFIG command.

Use the SERIALCONFIG command before using the INTERFACEMODE command on each port. Turn break detection off using the SERIALCONFIG command to stop the port from resetting because it is interpreting incoming bits as a break command.

Message ID: 1246

Syntax:

```
SERIALCONFIG [port] baud [parity[databits[stopbits[handshaking[break]]]]]
```

Factory Defaults:

```
serialconfig com1 9600 n 8 1 n on
serialconfig com2 9600 n 8 1 n on
serialconfig aux 9600 n 8 1 n off
```

Factory Defaults (Bluetooth model):

```
serialconfig com1 9600 n 8 1 n on
serialconfig com2 9600 n 8 1 n on
serialconfig aux 115200 n 8 1 n off
```

ASCII Example:

```
serialconfig com1 9600 n 8 1 n off
```

Field	Field Type	ASCII Value	Binary Value	Description	Format	Binary Bytes	Binary Offset
1	SERIALCONFIG Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary.	-	H	0
2	port	COM1		Select COM port 1 to configure	Enum	4	H
		COM2	2	Select COM port 2 to configure			
		AUX	3	Select COM port AUX to configure			
		THISPORT	6	Select the current COM port (default)			
		ALL	8	Select all COM ports			
3	bps/baud[a]	300, 600, 900, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800 and 921600		Communication baud rate (bps).	Ulong	4	H+4
4	parity	N	0	No parity (default)	Enum	4	H+8
		E	1	Even parity			
		O	2	Odd parity			
5	databits	7 or 8		Number of data bits (default = 8)	Ulong	4	H+12
6	stopbits	1 or 2		Number of stop bits (default = 1)	Ulong	4	H+16
7	handshake[b]	N	0	No handshaking (default)	Enum	4	H+20
		XON	1	XON/XOFF software handshaking			
8	break[c]	OFF	0	Disable break detection	Enum	4	H+24
		ON	1	Enable break detection (default)			
		AUTO	2				
		DEFAULT	3				

a. On models without Bluetooth, the AUX port does not support 230400, 460800 or 921600.
On models with Bluetooth, the AUX port (Bluetooth port) is fixed at 115200.

b. The AUX port does not support handshaking.

c. The AUX port does not support break detection.

B.9 SETCANNAME Sets the CAN name fields

This command sets the CAN device name fields.

Message ID: 1091

Abbreviated ASCII Syntax:

`setcanname` ManufacturerCode IndustryGroup DeviceClass DeviceClassInstance Function FunctionInstance ECUInstance PreferredAddress

Factory Default:

```
setcanname 305 2 0 0 23 0 0 28 can2
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETCANNAME header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary.	-	H	0
2	ManufacturerCode			CAN module's Manufacturer Code	ULong	4	H
3	IndustryGroup			Industry group number (default = 2)	ULong	4	H+4
4	DeviceClass			11783-5 Device class (default = 0)	ULong	4	H+8
5	DeviceClassInstance			11783-5 Device class instance (default = 0)	ULong	4	H+12
6	Function			11783-5 Function (default = 23)	ULong	4	H16
7	FunctionInstance			11783-5 Function instance (default = 0)	ULong	4	H+20
8	ECUInstance			11783-5 ECU Instance (default = 0)	ULong	4	H+24
9	PreferredAddress			Device default address on start up (default=28)	ULong	4	H+28
10	CanPort			CAN port to use (default = can2) **Note**: This field must be set to can2.	ULong	4	H+32

Appendix C Logs

C.1 Position Logs

C.1.1 NMEA Logs

The NMEA logs (receiver outputs) supported by the SMART6 are summarized in Chapter 3 of the OEM6 Family Firmware Reference Manual in section "NMEA Standard Logs". The available logs include:

- GPGGA, which outputs a log of position system fix data and undulation. There are variants of GPGGA, specifically:
  - GPGGARTK, which has greater precision than GPGGA but with the loss of the undulation field
  - GPGGALONG, which has both greater precision and the undulation field
- GPVTG, which outputs track made good and ground speed

Each of the available NMEA standard logs is described in more detail in its own section of Chapter 3 of the OEM6 Family Firmware Reference Manual.

The steps for configuring the receiver output, through the command line are:

1. Configure the communication port using the SERIALCONFIG command, described in *Section B.8, SERIALCONFIG Configures serial port settings* on page 62. To set COM port 2 as follows:

Bit Rate	9600
Parity	none
Data Bits	8
Stop Bits	1
Handshaking	None
Break	On

   enter the following string:

   ```
   serialconfig com2 9600 n 8 1 n on
   ```

2. Select and configure the NMEA string to output. The information is described in Chapter 3 Data Logs of the OEM6 Family Firmware Reference Manual, in the section for the particular log. For example, to log gpgga (position system fix data and undulation) at 2 Hz, enter the following string:

   ```
   log gpgga ontime 0.5
   ```

You can configure the log to output at various frequencies, as described in *LOG Request Logs from the Receiver* on page 57.

The above command line operations can also be carried out through NovAtel Connect. Information about configuring the communication port can be found in NovAtel Connect online help. The procedure for adding a NMEA log through NovAtel Connect is summarized as follows:

1. In the **Logging control** window, click *Logging to one or more of the receiver's serial ports*. The **Add Log** window displays.
2. Beside **Select list**, select *Complete List* or *NMEA List*.
3. Beside **Log to file**, select the NMEA log you want to add.
4. Select the port.
5. Configure the remaining fields then click *Add*.

C.1.2 NovAtel Position Logs

In addition to NMEA logs, NovAtel supports a range of non-NMEA position logs, described in the OEM6 Family Firmware Reference Manual, including:

- BESTPOS: This log contains the best available position computed by the receiver, for example:

```
log bestposa ontime 0.5
```

- BESTXYZ: This log contains the receiver's best available position and velocity in ECEF coordinates, for example:

```
log bestxyza ontime 1
```

C.2 Other Logs

The SMART6 firmware generates the logs in *Table 12, SMART6 Logs in Alphabetical Order*, in addition to those of the OEM6 Family log set. Refer to the OEM6 Family Firmware Reference Manual, which also contains procedures and explanations related to data logging and is available from our web site at: www.novatel.com/support/manuals/.

Table 12: SMART6 Logs in Alphabetical Order

Message ID	ASCII Log	Description
8193	RADARSIGNAL	Radar signal and position information (New SMART6 log)
37	VERSION	Hardware versions, software versions, and serial numbers (Existing OEM6 log extended to SMART6)

C.2.1 RADARSIGNAL ER Signal and Position Information

This log contains position and Emulated Radar (ER) signal information.

Message ID: **8193**

Log Type: **Asynch**

Recommended Input:

```
log radarsignala onchanged
```

ASCII Example 1 (stationary SMART6):

```
#radarsignala,com1,0,61.5,finesteering,1501,248381.628,00000000,8a1c,3723
;sol_computed,waas,0.0139,0.00,0.00*f0d580ca
```

ASCII Example 2 (moving SMART6):

```
#radarsignala,com1,0,42.5,finesteering,1428,206179.600,00000000,baa8,3349
;sol_computed,waas,0.3315,2,0.3152,473.97,29.62*c1479c20
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RADARSIGNAL header	Log header		H	0
2	sol status	Solution status, see *Table 14, Solution Status* on page 68	Enum	4	H
3	vel type	Velocity type, see *Table 13, Position or Velocity Type* on page 68	Enum	4	H+4
4	speed	Speed over ground (m/s)	Double	8	H+8
4	varf freq	External VARF output frequency (Hz)	Double	8	H+16
5	radar freq	Radar signal frequency (Hz) as output by the Emulated Radar Out signal. See *Section B.7, RADARCFG Configure the ER Output* on page 61.	Double	8	H+24
6	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+32
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 13: Position or Velocity Type

Type (binary)	Type (ASCII)	Description
0	NONE	No solution
1	FIXEDPOS	Position has been fixed by the FIX POSITION command
2	FIXEDHEIGHT	Position has been fixed by the FIX HEIGHT/AUTO command
8	DOPPLER_VELOCITY	Velocity computed using instantaneous Doppler
16	SINGLE	Single point position
17	PSRDIFF	Pseudorange differential solution
18	WAAS	Solution calculated using corrections from an SBAS
19	PROPAGATED	Propagated by a Kalman filter without new observations
32	L1_FLOAT	Floating L1 ambiguity solution
33	IONOFREE_FLOAT	Floating ionospheric-free ambiguity solution
34	NARROW_FLOAT	Floating narrow-lane ambiguity solution
48	L1_INT	Integer L1 ambiguity solution
49	WIDE_INT	Integer wide-lane ambiguity solution
50	NARROW_INT	Integer narrow-lane ambiguity solution

Table 14: Solution Status

Solution Status (Binary)	Solution Status (ASCII)	Description
0	SOL_COMPUTED	Solution computed
1	INSUFFICIENT_OBS	Insufficient observations
2	NO_CONVERGENCE	No convergence
3	SINGULARITY	Singularity at parameters matrix
4	COV_TRACE	Covariance trace exceeds maximum (trace > 1000 m)
5	TEST_DIST	Test distance exceeded (maximum of 3 rejections if distance > 10 km)
6	COLD_START	Not yet converged from cold start
7	V_H_LIMIT	Height or velocity limits exceeded (in accordance with export licensing restrictions)
8	VARIANCE	Variance exceeds limits
9	RESIDUALS	Residuals are too large
10	DELTA_POS	Delta position is too large
11	NEGATIVE_VAR	Negative variance
12	Reserved	
13	INTEGRITY_WARNING	Large residuals make position unreliable
14-17	Reserved for SPAN-capable receivers	
18	PENDING	When a FIX POSITION command is entered, the receiver computes its own position and determines if the fixed position is valid [a]
19	INVALID_FIX	The fixed position, entered using the FIX POSITION command, is not valid
20	UNAUTHORIZED	Position type is unauthorized - HP or XP on a receiver not authorized for it

a. PENDING implies there are not enough satellites being tracked to verify if the FIX POSITION entered into the receiver is valid. The receiver needs to be tracking two or more GPS satellites to perform this check. Under normal conditions you should only see PENDING for a few seconds on power up before the GPS receiver has locked onto its first few satellites. If your antenna is obstructed (or not plugged in) and you have entered a FIX POSITION command, then you may see PENDING indefinitely.

C.2.2 TILT Compensation

Tilt Compensation affects existing logs as follows:

- NovAtel logs that provide the Extended Solution Status field (BESTPOS and BESTXYZ, both documented in *OEM6 Family Firmware Reference Manual*) use the 0x80 bit to flag the fact that Tilt Compensation is being applied.
- For NMEA GPGGA, GPGGARTK, and GPGGALONG logs, the precision of various fields indicates whether the Tilt Compensation is being applied.

C.2.3 VERSION HW and SW Versions and Serial Numbers

The Component Type of the VERSION log, refer to the OEM6 Family Firmware Reference Manual, is extended to include SMART6 information as in *Table 15, Component Type*.

Table 15: Component Type

Binary Value[a]	ASCII Value	Description
0	UNKNOWN	Unknown Component
1	GPSCARD	OEM6 GPSCard Component
3	ENCLOSURE	SMART6 Receiver
8	USERINFO	User application information component
981073925 (0x3A7A0005)	DB_USERAPPAUTO	Auto-starting user application firmware

a. Unused numbers are reserved for future use.

```
<version com1 0 14.0 unknown 0 6.374 004c0000 3681 12433
<     4
<          gpscard "d2sr0gtt0a" "bjya13211868w" "oem615-1.01" "oem060230an0003"
           "oem060200rb0000" "2013/sep/11" "09:27:29"
<          db_userappauto "smart6" "0" "" "esmrt0200an0001" "" "2013/sep/12"
           "16:50:58"
<          enclosure "smart6  bt+t" "nmea13330008k" "0" "0" "0" "0" "0"
<          userinfo "lmx9830" "0212" "" "" "" "" ""
```

Appendix D Replacement Parts

The following are lists of the replacement parts available for the NovAtel SMART6 receiver. Should assistance be required or you need to order additional components, contact your local NovAtel dealer or *Customer Service* representative.

D.1 SMART6

Table 16: SMART6 Product

Part Description	NovAtel Part
SMART6	01019123
SMART6 with Tilt	01019125
SMART6 with Bluetooth	01019121
SMART6 with Bluetooth and Tilt	01019127
Cable: 14-pin socket to 3 DB-9 connectors, twisted CAN I/O pair, and other bare wire connectors (see *A.2.1 SMART6 Communication/Power Cable (01018999)* on *page 49*)	01018999
Mounting Plate Kit	01018317
Pole Mount Kit	01019142

D.2 User Manuals

Table 17: Reference User Manuals

Part Description	NovAtel Part
OEM6 Family Installation and Operation User Manual	OM-20000128
OEM6 Family Firmware Reference Manual	OM-20000129

The accessories above are also available from www.novatel.com

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